Nine New Species of Hawaiian Leaf-roller Moths (Lepidoptera: Tortricidae), Including One Probably Extinct Species

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Abstract. Nine new species of Tortricidae are described from the Hawaiian Islands: *Bactra omoomoo*, **sp. nov.** (O'ahu), *Eccoptocera kualii*, **sp. nov.** (O'ahu), *Eccoptocera kukona*, **sp. nov.** (Kaua'i), *Eccoptocera iwipookua*, **sp. nov.** (Kaua'i), *Panaphelix nalowale*, **sp. nov.** (O'ahu), *Panaphelix mapala*, **sp. nov.** (Hawai'i), *Panaphelix kikokea*, **sp. nov.** (Maui), *Pararrhaptica huihui*, **sp. nov.** (Kaua'i), and *Spheterista hoihoi*, **sp. nov.** (Kaua'i). Unfortunately, *Panaphelix nalowale* has not been seen since its only collection 50 years ago and is probably extinct. With the possible exceptions of *Bactra omoomoo* and *Panaphelix kikokea*, all species are believed to be single-island endemics. In addition, *Bactra iomolybda* Meyrick, **reinst. stat.** (Hawai'i), is resurrected from synonymy of *Bactra straminea* (Butler) (O'ahu) and redescribed. The conservation status for all species is discussed in the hopes of encouraging action on their behalf.

Key words. Pacific, conservation, endemic, taxonomy, endangered

Island ecosystems, especially those that are volcanic and isolated from continents, often possess highly disharmonic floras and faunas (Carlquist 1966, Gillespie and Roderick 2002, König et al. 2021). The Hawaiian Islands, being the most isolated archipelago in the world, are an excellent example of such disharmony. Only 50% of globally extant insect orders and 15% of insect families are present in the native Hawaiian fauna (Howarth and Mull 1992). Of the approximately 130 currently recognized Lepidoptera families, only 21 were present in Hawai'i before the arrival of humans (Austin and Rubinoff 2023). The majority of insect families are represented by a single radiation stemming from a single ancestral colonization event, such that only 350–400 original founders are believed to have given rise to the estimated 10,000 native insect species in Hawai'i today (Howarth 1990). However, the leaf-roller moths (Tortricidae) buck this trend dramatically: they appear to have independently colonized the Hawaiian Islands more than a dozen times (Hembry et al. 2021, Austin and Rubinoff 2023), suggesting that some families may be better equipped or pre-disposed to colonization in Hawai'i. Little is known about the true diversity of Tortricidae in Hawai'i and many species still lack a scientific name, the most basic tool in recognizing and conserving biodiversity. Unfortunately, at least 17 species of Tortricidae and hundreds of other endemic Hawaiian Lepidoptera are presumed extinct (Austin and Rubinoff 2022; Austin and Rubinoff 2024). Recent field work and museum visits have uncovered several new species, ranging from those that are locally common to others which are rare or already extinct before they could be recognized.

Methods and Materials

Genitalia dissection methods follow Landry (2007). Genitalia were stained with a combination of Eosin Y and chlorazol black and either slide-mounted or stored in glycerol-filled microvials pinned beneath the specimen. Forewing length (FWL) was measured in a straight line from the base of the costa to the apex (including the fringe) to the nearest tenth-millimeter. Images of adults and genitalia were captured using a Macroscopic Solutions Macropod Pro and Canon EOS 6D DSLR camera body using the Macro Photo MP-E 65 mm f/2.8 1–5× manual focus lens for EOS. Images were stacked using Zerene Stacking Software v1.04. Figures were manipulated with Affinity Photo v1.10.6 and Affinity Designer v1.10.8.

Label data was transcribed verbatim except for corrections to Hawaiian spelling and diacritics. Any other corrections or clarifications to data labels are provided in brackets following the verbatim label. Measurements in imperial units are presented verbatim with metric units provided in brackets. Separate labels on a single specimen are designated by slashes (/). Morphological terminology follows Gilligan et al. (2008) and Austin and Dombroskie (2020) for wing pattern elements and Horak (2006) for everything else, except for "aedeagus" which we refer to as the "phallus" as per Kristensen (2003).

Acronyms and Abbreviations

BPBM: Bernice Pauahi Bishop Museum; Honolulu, HI, USA
CNC: Canadian National Collection of Insects, Arachnids and Nematodes; Ottawa, ON, Canada
diss.: dissection
FW: forewing
FWL: forewing length
HDOA: Hawai'i Department of Agriculture; Honolulu, HI, USA
HW: hindwing
NHMUK: Natural History Museum, London; London, UK
UHIM: University of Hawai'i Insect Museum; Honolulu, HI, USA

Results

Bactra iomolybda Meyrick, 1932, stat. rest.

Bactra straminea (Butler) forma *iomolybda* Meyrick, 1932
(Diakonoff, 1959: 183)
Figs. 1A, B; 3A; 7A

Diagnosis. The dark orange forewing scaling of *Bactra iomolybda* (Hawai'i), coupled with its small size, will readily distinguish it from any other species of *Bactra* in Hawai'i. It could be superficially confused with several species of Hawaiian *Cydia*, but the genitalia are diagnostic.

Type material. Lectotype: Hawai'i: 1♂, Kīlauea; P[erkins]; [19]10 / J. F. G. C. diss. #9545 (NHMUK) [examined].

Paralectotype: Hawai'i: 1♂, same as lectotype (NHMUK) [examined].

Additional material examined; Hawai'i: 1♂, Hawai'i Volcanoes N[ational] P[ark], nr. Lava Tree Molds; 19.4319, -155.2835; 1230m; 16–17 iii 2022; K.A. Austin, D. Rubinoff; [UV] bucket trap / DNA extraction KA0530 / KAA diss. #0767 (UHIM). 1♀, Hāmākua(?); 1911 [abdomen missing] (HDOA). 1♀, Hawai'i National Park, Kīlauea Sect[ion]; 12 vi 1947; C. J. Davis; ex light trap (HDOA). 1♂, same as previous except 12 x 1946 (HDOA). 1♂, same as previous except 4 vi 1947 (HDOA). 1♀, Kīlauea, Fern Forest Trail near gate; 20 vii [19]34; O. H. Swezey / KAA diss. #1165 (HDOA). 1♂, Haw[ai'i] Nat[iona]l Park, Kīlauea; 1200m; 20 iii 1961 / S. Quate, L. Quate; light trap (BPBM). 1♂, Kīl[auea], vi [19]03; abundant and not varying in colour / R.C.L. Perkins collection (BPBM).

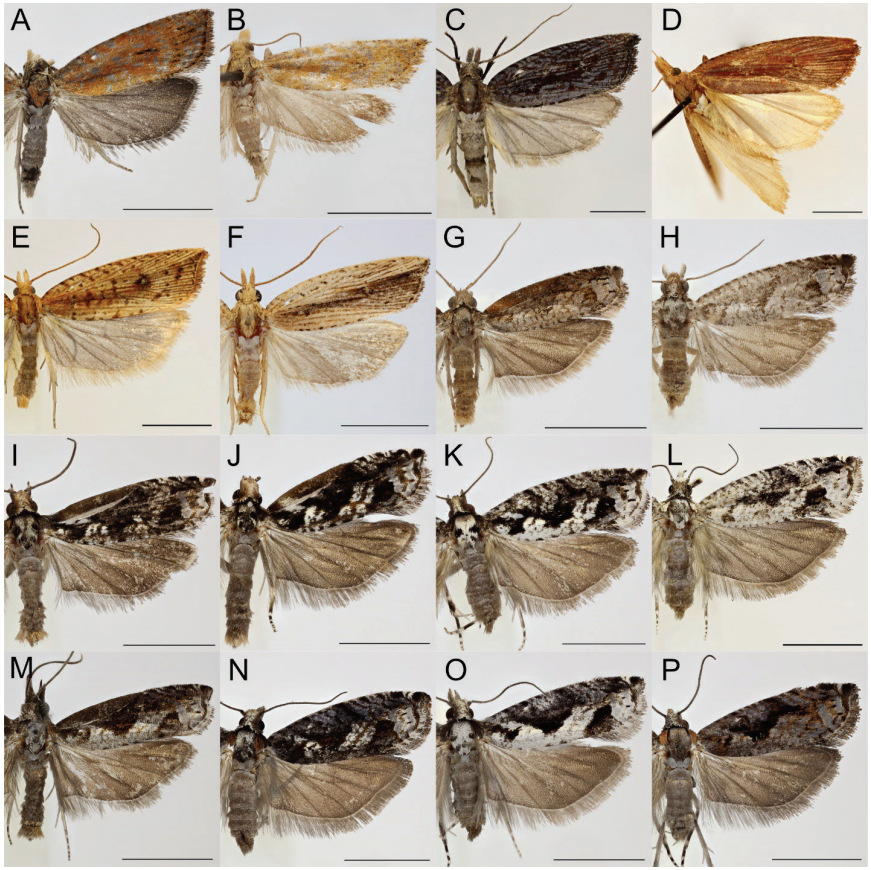

Figure 1. Olethreutinae adults. A. *Bactra iomolybda*, ♂, Hawai'i (UHIM). B. *Bactra iomolybda*, ♀, Hawai'i (HDOA). C. *Bactra omoomoo*, holotype, ♂, O'ahu (UHIM). D. *Bactra omoomoo*, paratype, ♀, O'ahu (BPBM). E. *Bactra ?straminea*, ♂, Maui (UHIM). F. *Bactra ?straminea*, ♂, Moloka'i (UHIM). G. *Eccoptocera kualii*, holotype, ♂, O'ahu (UHIM). H. *Eccoptocera kualii*, paratype, ♀, O'ahu (UHIM). I. *Eccoptocera iwipookua*, holotype, ♂, Kaua'i (UHIM). J. *Eccoptocera iwipookua*, paratype, ♂, Kaua'i (UHIM). K. *Eccoptocera iwipookua*, paratype, ♀, Kaua'i (UHIM). L. *Eccoptocera iwipookua*, paratype, ♀, Kaua'i (UHIM). M. *Eccoptocera kukona*, holotype, ♂, Kaua'i (UHIM). N. *Eccoptocera kukona*, paratype, ♀, Kaua'i (UHIM). O. *Eccoptocera kukona*, paratype, ♀, Kaua'i (UHIM). P. *Eccoptocera kukona*, paratype, ♀, Kaua'i (UHIM). Scale bar = 5 mm.

Redescription. Male (n=7). ***Head.*** Scales on frons pale yellow, dorsal half with longer, slightly drooping, brownish-yellow scales; scales on vertex pale yellow; labial palpus approximately 2× width of compound eye, scales on lateral surface pale yellow, occasionally with scattered dark brown or black scales, scaling on second segment greatly expanded dorsally and ventrally; medial surface pale yellow. Ocellus moderate in size, separated from compound eye

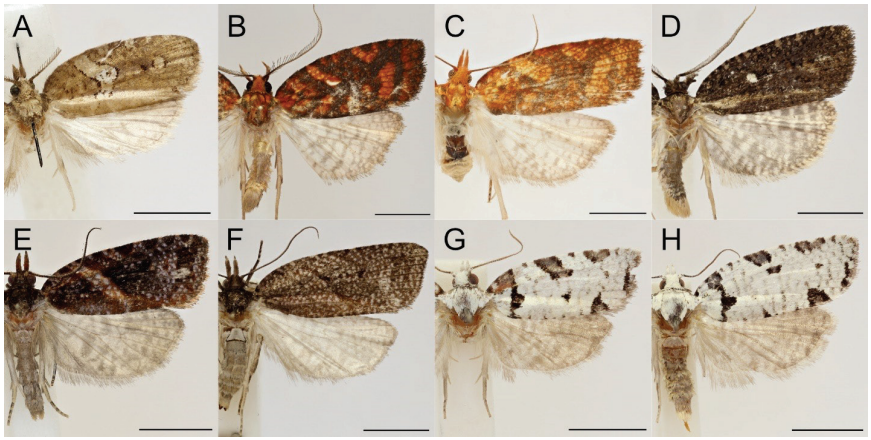

Figure 2. Tortricinae adults. A. *Panaphelix nalowale*, holotype, ♂, O'ahu (BPBM). B. *Panaphelix mapala*, holotype, ♂, Hawai'i (UHIM). C. *Panaphelix mapala*, paratype, ♀, Hawai'i (UHIM). D. *Panaphelix kikokea*, holotype, ♂, Maui (UHIM). E. *Pararrhaptica huihui*, holotype, ♂, Kaua'i (UHIM). F. *Pararrhaptica huihui*, paratype, ♀, Kaua'i (NHMUK). G. *Spheterista hoihoi*, paratype, ♂, Kaua'i (NHMUK). H. *Spheterista hoihoi*, paratype, ♀, Kaua'i (NHMUK). Scale bar = 5 mm.

by width of ocellus. Scape with scaling dark brown at base, dirty yellow at apex; sensillae approximately width of flagellomere or nearly so; dorsal scales of flagellum dirty yellow to pale yellow near base, becoming darker, scarcely discernable from dark brown flagellum apically. ***Thorax.*** Dorsum with scaling red-orange to pale yellow-orange; tegulae concolorous, occasionally with intermixed dark brown or black scales. Lateral surface of foreleg brown to dark brown, scattered reddish-brown scales on femur and tibia; lateral surface of midleg similar, slightly paler, without such scattered reddish-brown scales; hind leg pale yellow with gray scales scattered throughout. Dorsal surface of FW (Fig. 1A; FWL: 7.2–7.6 mm) with ground color burnt orange, with patches of silver scales scattered throughout between veins; black scales present along veins, especially distally, at end of cell (obscured by orange scales in some specimens), and along termen; fringe with a basal row of burnt orange scales and a distal row of silver scales. Ventral surface of FW dark gray, pale orange along costa. Dorsal surface of HW gray, darker distally. Ventral surface of HW slightly paler than dorsal surface, but otherwise similar. ***Abdomen.*** Vestiture of abdomen concolorous with HW. Genitalia (Fig. 3A) with uncus short, downcurved, with lateral and apical margin densely fringed with robust peg-like setae; socii large, membranous, slightly depressed proximally, with long, dense setae on dorsal surface; tegumen moderate, well-sclerotized, convex or subtriangular, somewhat inflated; gnathos absent; valva typical for subgenus *Chiloides*, with large, elliptical, lobe-like sacculus with 12–15 large, thorn like setae on ventral margin, loosely clustered into 4–5 distinct groups; intermediate lobe well-developed, curved, with a dense row of peg-like setae on distal margin; 3–5 thorn-like setae present near base of these peg-like setae; cucullus long, moderate in width, gently sinuate, with scattered bristle-like setae on inner

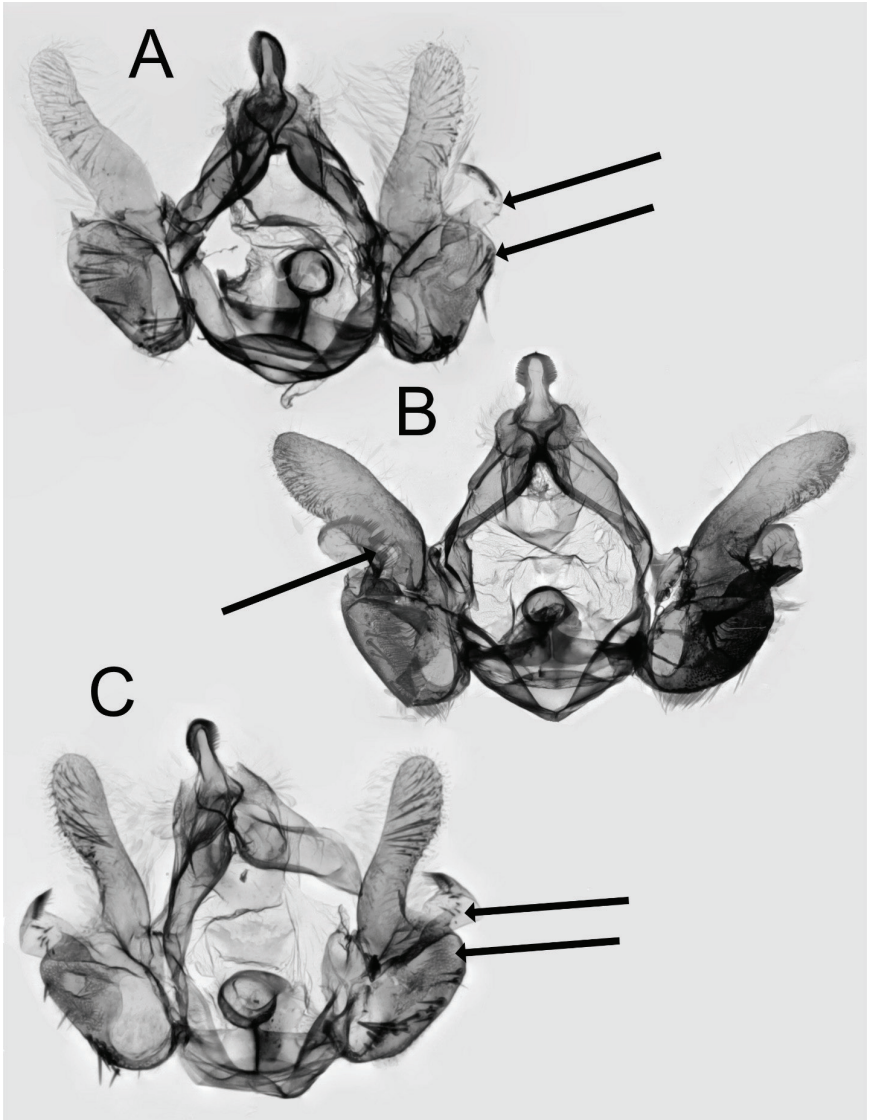

Figure 3. *Bactra* male genitalia. **A.** *Bactra iomolybda*, KAA diss. #0767, Hawai'i (UHIM). Top arrow indicates the lower number of spines on the intermediate lobe as compared to *B.* ?*straminea*. Bottom arrow indicates the additional row of spines on the sacculus as compared to *B.* ?*straminea*. **B.** *Bactra omoomoo*, paratype, O'ahu, KAA diss. #0878 (UHIM). Arrow indicates the densely packed, regularly spaced, spine-like setae along lateral margin of intermediate lobe. **C.** *Bactra* ?*straminea*, O'ahu, KAA diss. #0797 (UHIM). Top arrow indicates the higher number of spines on the intermediate lobe as compared to *B. iomolybda*. Bottom arrow indicates the absences of the additional row of spines on the sacculus compared to *B. iomolybda*.

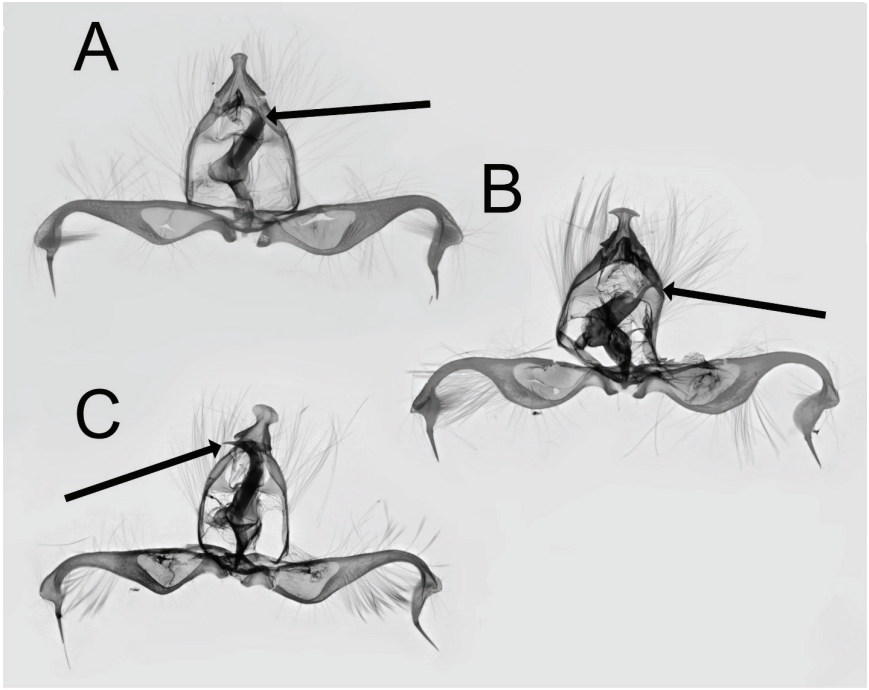

Figure 4. *Eccoptocera* male genitalia. **A.** *Eccoptocera kualii*, holotype, KAA diss. #0980, O'ahu (UHIM). Arrow indicates the moderately upcurved phallus of this species. **B.** *Eccoptocera iwipookua*, holotype, Kaua'i, KAA diss. #1105 (UHIM). Arrow indicates the uniquely downcurved phallus of this species. **C.** *Eccoptocera kukona*, holotype, Kaua'i, KAA diss. #1194 (UHIM). Arrow indicates the very long, upcurved phallus of this species.

face; juxta broad, short, well-sclerotized, nearly fused with caulis. Phallus short, robust, slightly flattened, without observed cornuti or spines.

Description. Female. (n=3). ***Head.*** Scaling on frons, vertex, labial palpus similar to male, often paler; sensillae approximately 0.5× width of flagellomere. ***Thorax.*** Similar to male, but more widely varying in size (FWL 6.4–7.7 mm), often paler, with less extensive black scaling. ***Abdomen.*** Vestiture of abdomen pale golden brown. Genitalia (Fig. 7A) with papillae anales elongate, slightly widened distally, evenly roughened on ventral surface; apophyses posteriores, apophyses anteriores straight, approximately 0.33× length of S7; hind margin of S7 membranous, folded to form deep, pouch-like structure; sterigma large, broad, bowl-shaped; ostium wide, ring-like, margins well-defined; ductus bursae straight, membranous; colliculum absent; corpus bursae elliptical, large, membranous; signum present as a small, scobinate, weakly invaginated, plate-like patch.

Biology. The life history of *Bactra iomolybda* is unknown. Most *Bactra* globally are stem-borers in Cyperaceae and Poaceae. Swezey (1954) mentioned a common, apparently undescribed species of *Bactra* reared from stems of the native

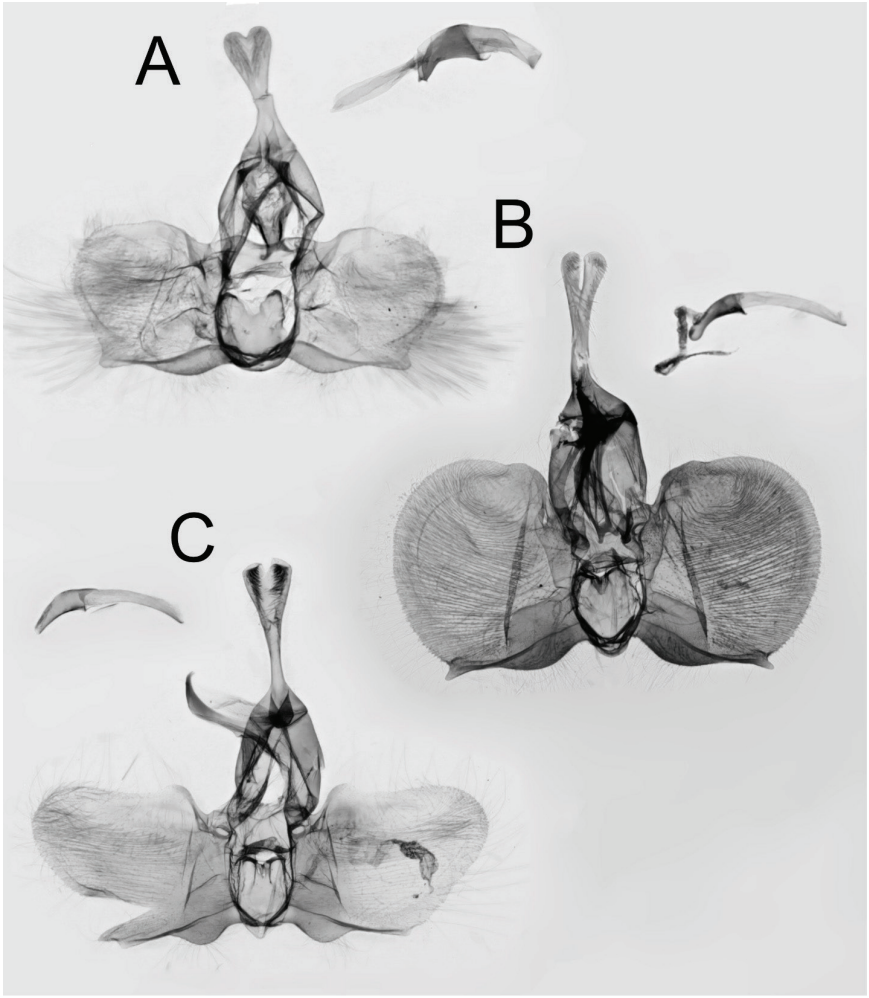

Figure 5. *Panaphelix* male genitalia. **A.** *Panaphelix nalowale*, holotype, KAA diss. #0420, O‘ahu (UHIM). **B.** *Panaphelix mapala*, holotype, Hawai‘i, KAA diss. #1121 (UHIM). **C.** *Panaphelix kikokea*, holotype, Maui, KAA diss. #0810 (UHIM).

‘ohe (*Isachne distichophylla*; Poaceae) from Kīlauea, distinct from the “much larger” *B. straminea*. That might be in reference to *B. iomolybda*, but we have not been able to locate any such reared vouchers for confirmation.

Distribution. *Bactra iomolybda* is endemic to Hawai‘i island, where it appears to be largely restricted to the area around Kīlauea.

Comments. Diakonoff (1959) treated *B. iomolybda* Meyrick as a “form” of *B. straminea* (Butler) as he believed it only differed in the presence of “a transverse series of additional moderate spines across the inner side of the disc of the saucculus [sacculus], running beside and parallel to the base of the median coronate appendage

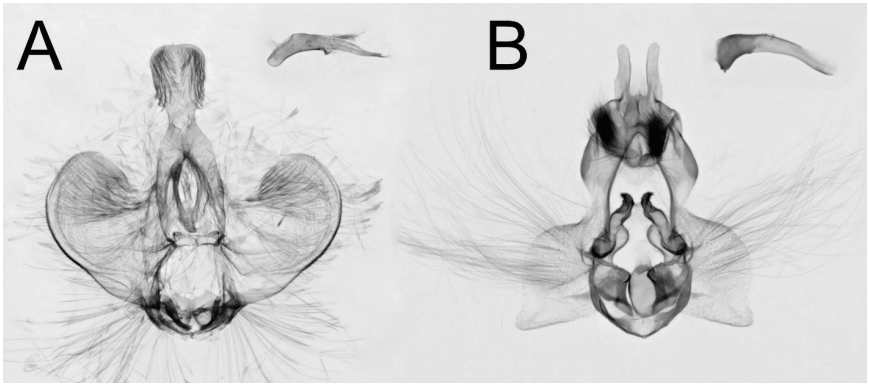

Figure 6. *Pararrhaptica* and *Spheterista* male genitalia. **A.** *Pararrhaptica huihui*, holotype, KAA diss. #1080, Kaua'i (UHIM). **B.** *Spheterista hoihoi*, paratype, Kaua'i, BM genitalia slide 21342 (NHMUK).

of the valva (valvula) ["intermediate lobe" *sensu* Horak 2006]." Unfortunately, the holotype of *B. straminea* in NHMUK is missing its abdomen; specimens and genitalia figured by Diakonoff (1956, 1959) and Zimmerman (1978) were identified presumably based on external similarities to the holotype. Preliminary COI sequence data and examination of male genitalia suggests that *B. straminea* is a species complex, with multiple species occurring sympatrically on O'ahu, the type locality for the species. It is unclear if the genitalia described and previously illustrated by Zimmerman (1978) and purported to be *B. straminea* are conspecific with the holotype or represent one or more undescribed cryptic species. It is appropriate to treat *B. straminea* as a species complex until detailed study of the male genitalia and genetics can be undertaken.

Thankfully, *B. iomolybda* is readily distinguishable from all specimens that could be assigned to the *B. straminea* species complex based on forewing pattern and genitalia. The forewing of *B. iomolybda* (Figs 1A, B) is a brilliant dark orange, often intermixed with metallic blue-gray dots and streaks when fresh. The forewing of the *Bactra straminea* complex is variable (Figs 1E, F), but most often straw yellow or pale brown, typically with brown or gray streaks along the veins. Not only does *B. iomolybda* possess the additional row of spines on the sacculus as described by Diakonoff (1959), but it also differs in the distribution of spines along the base of the intermediate lobe compared to the *B. straminea* complex. *Bactra iomolybda* has a cluster of 2–5 moderate spines towards the apex and 3–5 additional slender, weakly developed spines evenly spaced along the ventrolateral face of the intermediate lobe (Fig. 3A). In contrast, most *B. straminea* have 6–10 moderate spines clustered towards the apex of the intermediate lobe without any slender spines along the ventrolateral face (Fig. 3C). Female genitalia of *B. iomolybda* differ from *B. straminea* in the much smaller signum (Fig. 7A), which is scarcely invaginated from the corpus bursae, compared to the much larger signum of the *B. straminea* complex (Fig. 7C).

Conservation Status. *Bactra iomolybda* is likely endangered. This species is only known from a single modern record. With the exception of

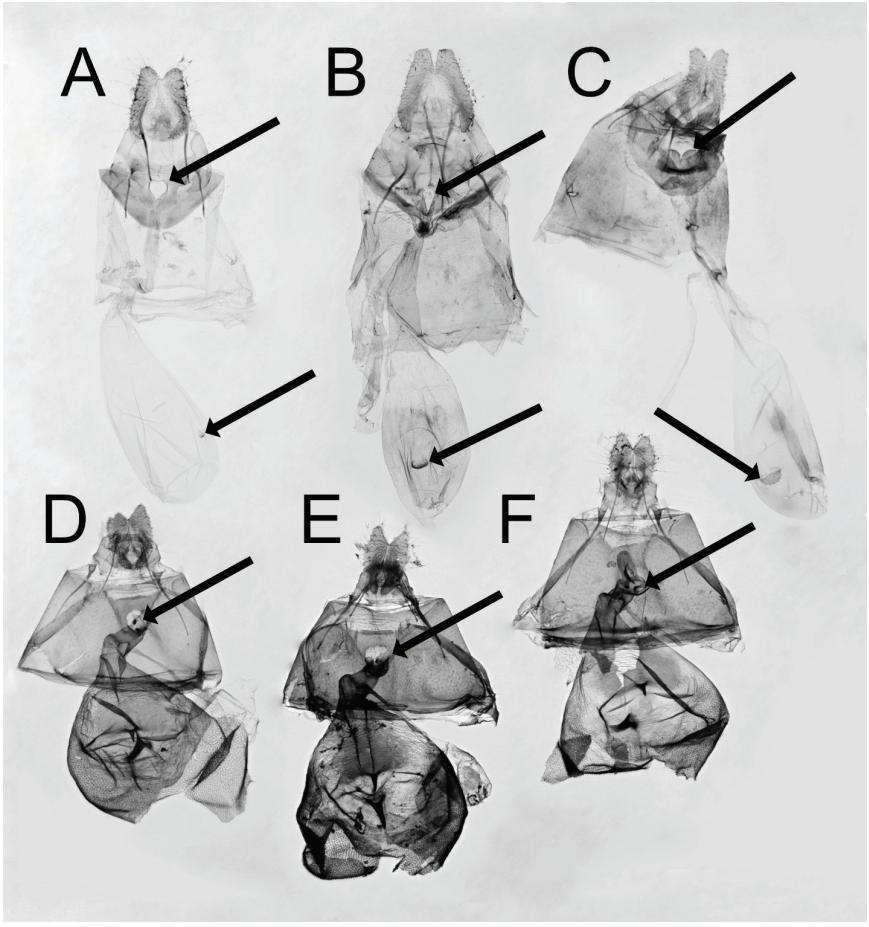

Figure 7. *Bactra* and *Eccoptocera* female genitalia. **A.** *Bactra iomolybda*, Hawai'i, KAA diss. #1165 (HDOA). Top arrow indicates the well-sclerotized, tunnel-like ostium of this species. Bottom arrow indicates the minute signum of this species. **B.** *Bactra omoomoo*, paratype, O'ahu, KAA diss. #1224 (BPBM). Top arrow indicates the deep, V-shaped, open-faced ostium of this species. Bottom arrow indicates the large signum of this species. **C.** *Bactra* ?*straminea*, O'ahu, KAA diss. #0617 (UHIM). Top arrow indicates a unique, split sterigma (but see comments under *B. iomolybda* regarding the identity of the *B. straminea* species complex). Bottom arrow indicates the large signum of this species**. D.** *Eccoptocera kualii*, paratype, O'ahu, KAA diss. #0979 (UHIM). Arrow indicates the triangular tooth-like process partially obscuring the ostium of this species. **E.** *Eccoptocera iwipookua*, paratype, Kaua'i, KAA diss. #1104 (UHIM). Arrow indicates the absence of any process obscuring the ostium of this species. **F.** *Eccoptocera kukona*, paratype, Kaua'i, KAA diss. #1098 (UHIM). Arrow indicates the slight thickening of the right side of the ostium, which is typically noticeable in slide-mounted specimens but is also present in *E. foetorivorans* (Butler).

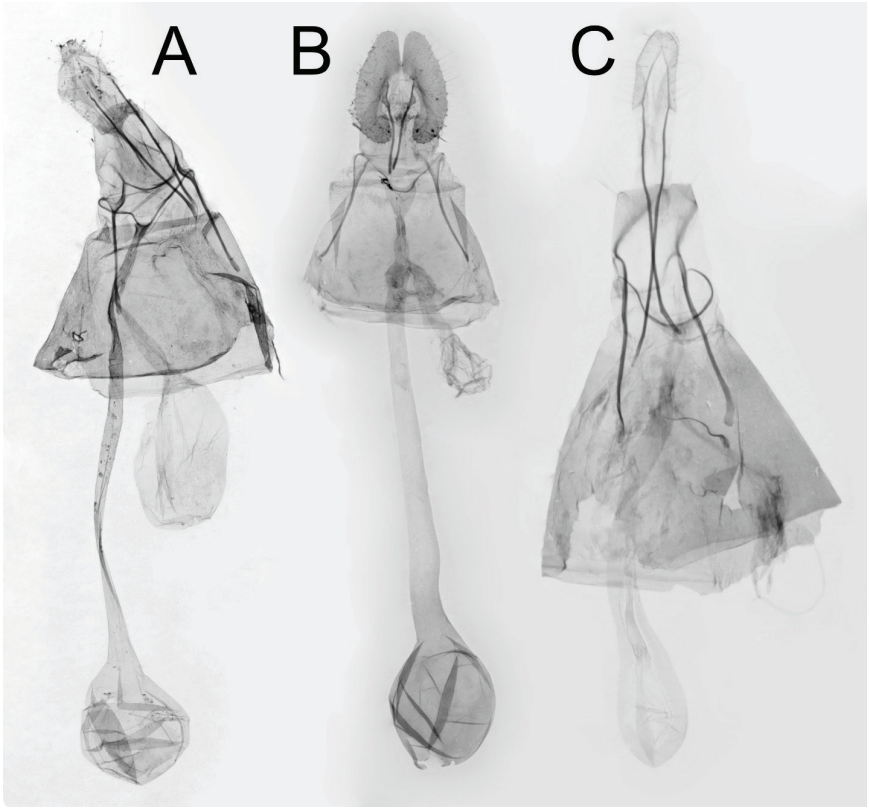

Figure 8. *Panaphelix*, *Pararrhaptica*, and *Spheterista* female genitalia. **A.** *Panaphelix mapala*, paratype, Hawai'i, KAA diss. #1158 (UHIM). **B.** *Pararrhaptica huihui*, paratype, Kaua'i, KAA diss. #1223 (NHMUK). **C.** *Spheterista hoihoi*, Kaua'i, KAA diss. #0358 (UHIM).

one historical specimen with a semi-legible label possibly from Hāmākua, all known specimens are from the immediate vicinity of Kīlauea. Determining the host plant(s) of *B. iomolybda* (see Biology section above) would greatly improve the conservation prospects of this species.

Bactra omoomoo, sp. nov.

Figs. 1C, D; 3B; 7B, 9A

Diagnosis. *Bactra omoomoo* (O'ahu) can be distinguished from other species of *Bactra* in Hawai'i by the combination of its large size and distinctive dark brown forewing scaling with blue-gray strigulae. Males can be distinguished from other species of Hawaiian *Bactra* by the much wider cucullus and the densely packed, regularly spaced, spine-like setae along lateral margin of intermediate lobe (typically fewer and more irregularly spaced in members of the *B. straminea* complex). Females can be distinguished by the deep, weakly sclerotized, V-shaped ostium, which is much shallower, more rounded, and often well-defined in members of the *B. straminea* complex.

Type material. Holotype: O'ahu: ♂, 'Ewa Forest Reserve, Poamoho Cabin; 21.5304, -157.9202; 770m; 25–26 xi 2022;

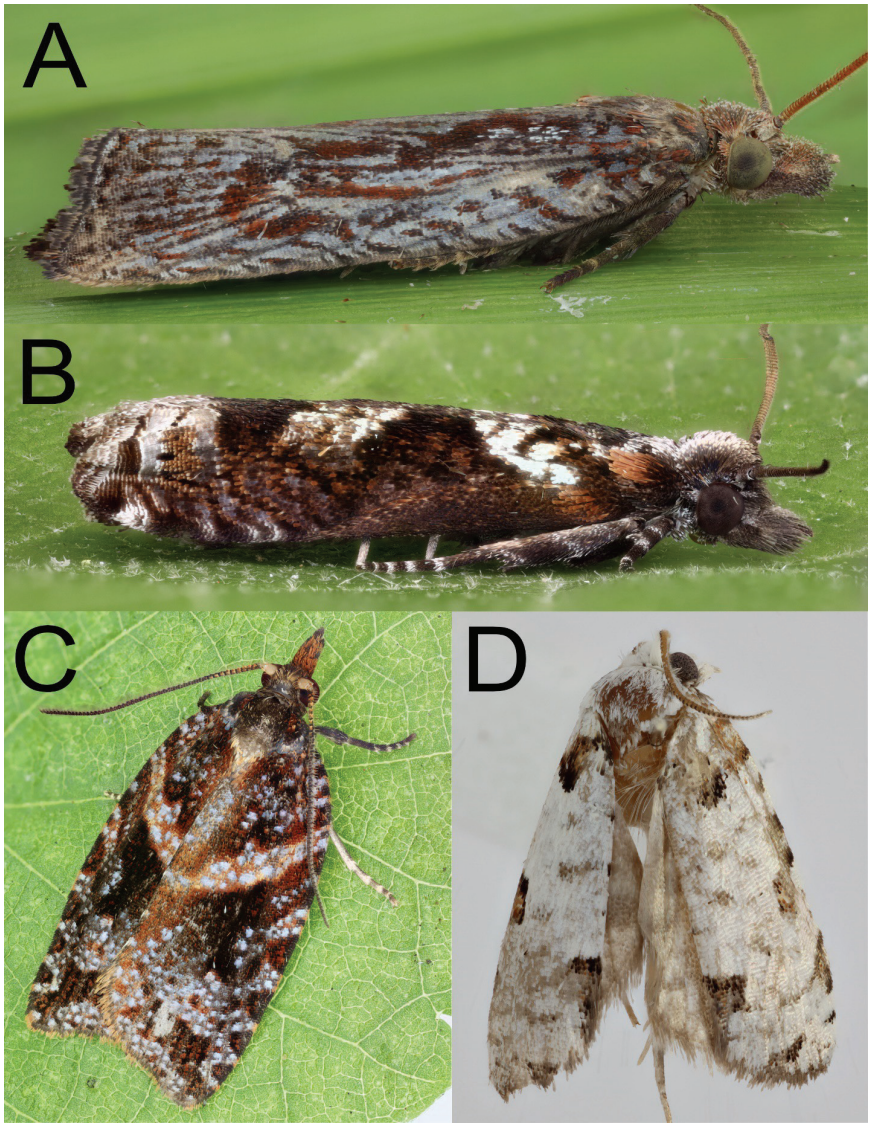

Figure 9. A. Live *Bactra omoomoo*, ♂, O‘ahu. B. Live *Eccoptocera kukona*, ♂, Kaua‘i. C. Live *Pararrhaptica huihui*, ♂, Kaua‘i. D. *Spheterista hoihoi*, holotype, ♂, O‘ahu (UHIM).

K. A. Austin, K. Faccenda, D. Cuthrell; UVLED light sheet / DNA extraction KA0727 / KAA diss. #0956 (UHIM). **Paratypes** (84♂♂, 3♀♀): O‘ahu: 10♂♂, same data as holotype / DNA extraction KA0726 / KAA diss. #0955 (UHIM). 2♂♂, ‘Ewa Forest Reserve, Poamoho Trail; 21.5331, –157.9254; 705m; 25–26 xi 2022; K. A. Austin, K. Faccenda, D. Cuthrell; UV bucket trap (UHIM). 1♂,

‘Ewa Forest Reserve, K[o‘olau] S[ummit] T[rail] S of Poamoho Cabin; 21.5286, -157.9202; 760m; 25–26 xi 2022; K. A. Austin, K. Faccenda, D. Cuthrell; UV bucket trap (UHIM). 8♂♂, same data as previous except 21.5270, -157.9198; 775m (UHIM). 3♂♂, Ko‘olau Mts., Poamoho Trail cabin; 2600ft; 15 xii 1978; F. G. Howarth (BPBM). 1♀, same as previous except 15 – 16 xii 1978; F. G. Howarth, S. L. Montgomery (UHIM). 2♂♂, Poamoho Cabin, 2500ft; 16 xii 1978; S. L. Montgomery (BPBM). 11♂♂, Ko‘olau Mts., Poamoho Trail shelter; 760m; 17 xii 1977; F. G. Howarth (BPBM). 4♂♂, Kōnāhuanui; 3105 ft; 24 i 1998; M. Heddle, C. Chimera; black light (BPBM). 1♂, ‘Ewa Forest Reserve, Mānana Ridge, along fenceline; 21.4491, -157.8917; 545m; 24 – 25 xi 2021; K. A. Austin, K. Faccenda; UVLED light sheet / DNA extraction KA0391 / KAA diss. #0654 (UHIM). 4♂♂, Honolulu Watershed F[orest] R[eserve], K[o‘olau] S[ummit] T[rail] W of Hawai‘i Loa Ridge summit; 21.3245, -157.7420; 755m; 3–4 ix 2022; K. A. Austin, K. Faccenda; [UV] bucket trap (UHIM). 30♂♂, Honolulu Watershed F[orest] R[eserve], Hawai‘i Loa Ridge, nr. summit; 21.3233, -157.7420; 705m; 3–4 ix 2022; K. A. Austin, K. Faccenda; [UV] bucket trap / DNA extractions KA0634, KA0635 / KAA diss. #0876, #0877, #0878 (UHIM). 5♂♂, Honolulu Watershed F[orest] R[eserve], Wailupe Ridge; 21.3214, -157.7490; 620m; 24–25 ix 2022; K. A. Austin, M. Staab; [UV] bucket trap / DNA extraction KA0650 / KAA diss. #0890 (UHIM). 2♂♂, Mānoa Valley, Substation H[awai‘i] S[ugar] P[lanters’] A[ssociation]; 7 iii [19]45; H. Brodie; ex light trap (HDOA). 1♂, same as previous except 18 iii [19]45 (HDOA). 1♀, Pacific H[eigh]ts; 27 v [19]06; ex Vincentia [=Machaerina] angustifolia (HDOA). 1♀, Lanihuli; 18 vii [19]20; E. H. Bryan, Jr. (BPBM).

Other material examined. 1 larva, Pacific H[eigh]ts; 27 v [19]06; ex *Vincentia* [=*Machaerina*] (HDOA).

Description. Male (n=85). ***Head.*** Scales on frons long, erect, entirely dark brown except gray at apex, occasionally with scattered light pinkish-red scales; scales on vertex concolorous with scaling on frons; labial palpus long, approximately 3.5× width of compound eye, scales on lateral surface concolorous with scaling on frons except light pinkish-red scales more common; medial surface with scaling pale yellow to white. Ocellus moderate, slightly depressed, separated from compound eye by approximately 1× width of ocellus. Scape with scaling pale brown; sensillae short, approximately 0.5× width of flagellomere; dorsal scales of flagellum silver. ***Thorax.*** Dorsum with scaling short, tightly appressed, pale reddish-brown; longer, darker reddish-brown or blueish-gray scales present laterally; tegulae intermixed with mahogany, dark gray, and black scales. Lateral surface of foreleg and midleg entirely dark brown, tarsal segments ringed with pale yellow at apices; hindlegs entirely pale yellow to white, tarsal segments similar to forelegs and midlegs. Dorsal surface of FW (Fig. 1C; FWL: 8.9–11.6 mm) with ground color dark brown and mahogany, strongly overlaid with metallic blueish-gray scaling, especially between veins, as paired costal strigulae, and along inner margin; black scaling present along veins and as a distinctive dot or streak at end of cell; fringe black with scattered mahogany scales. Ventral surface of FW dark brown, golden-brown terminally. Dorsal surface of HW pale brown, fringe concolorous. Ventral surface of HW concolorous with dorsal surface of HW, but slightly paler. ***Abdomen.*** Vestiture of abdomen pale yellow to light brown, but often grease-stained which gives some segments a much darker appearance. Genitalia (Fig.

3B) with uncus short, well-developed, downcurved, spatulate, densely fringed on lateral and apical margin with robust, flattened, peg-like setae; socii situated at base of uncus, large, membranous, flap-like, with long, dense, hair-like setae; tegumen broad, convex, well-sclerotized, somewhat inflated dorsally; gnathos absent; valva typical for subgenus *Chiloides*, with large, greatly inflated, lobe-like sacculus; sacculus with dense cluster of 15–20 well-developed spine-like setae on ventral margin and 4–5 slightly larger, longer setae on lateral margin; face of sacculus with well-developed mound-like process; intermediate lobe well-developed, curved, with regularly-spaced, dense, peg-like setae on distal margin; 8–19 longer, more irregularly spaced, acute setae present at base of these peg-like setae; regularly-spaced, thin, spine-like setae present along lateral margin of intermediate lobe towards base; cucullus long, broad, apically rounded, with a large, dense patch of thin, bristle-like setae towards apex; juxta broad, short, well-sclerotized, bowl-shaped, nearly fused with caulis. Phallus short, robust, somewhat ventrodorsally flattened, without cornuti or spines.

Female (n=3). ***Head.*** Scaling on frons, vertex, labial palpus, scape, and flagellum similar to male but often slightly paler, straw yellow; sensillae only 0.25× width of flagellomere. ***Thorax.*** Similar to male except larger (Fig. 1D; FWL: 12.4–13.5 mm), dorsal surface of forewing paler, often golden brown (one specimen with distinct dark brown medial streak); with less apparent blueish-gray scaling; hindwing paler. ***Abdomen.*** Vestiture of abdomen golden brown. Genitalia (Fig. 7B) with papillae anales subtriangular, lateral margin slightly convex, with shallow anteromedial excavation, roughened on ventral surface; apophyses posteriores long, slender, approximately 0.75× length of S7; apophyses anteriores laterally directed, slightly curved, approximately 0.33× length of S7; hind margin of S7 highly membranous, folded to form pocket-like structure obscuring much of the sterigma; sterigma large, broad, band-like; ostium deep, acute, V-shaped, weakly sclerotized; ductus bursae straight, membranous, slender at base but widening beyond 0.25× to nearly width of corpus bursae; ductus seminalis arising at 0.25× length of ductus bursae; colliculum absent; corpus bursae scarcely differentiated from ductus bursae, elliptical, not greatly inflated; signum a moderately sized, roughly scobinate, invaginated, quadrate, plate-like structure.

Biology. One adult female and one larva in HDOA were reared from ʻuki (*Machaerina angustifolia*; Cyperaceae). We have commonly found larvae of what appear to be this species boring into the stems of ʻuki, especially at the base of inflorescences. Unfortunately, collected larvae have so far failed to mature.

Distribution. This species occurs in the Koʻolau Range of Oʻahu above 500 meters virtually wherever its host plant, ʻuki (*Machaerina angustifolia*) grows. It seems to be especially abundant along the windswept peaks and summits of the Koʻolau Range and might be expected on the sheer cliffs, hanging valleys, and waterfalls along the windward side which are virtually inaccessible to collectors. Similar large brown *Bactra* have been collected on Kauaʻi, Molokaʻi, Maui, and Hawaiʻi island. It is not yet clear if these represent *B. omoomoo* or similar, undescribed species. Preliminary molecular data suggest they may be distinct species, but more data is needed.

Etymology. From Hawaiian ʻōmo-ʻomoʻo, meaning "ridge" or "crest," as of mountains, referring to the high peaks of the Koʻolau Mountains where this species can be found.

Comments. Specimens of *B. omoomoo* have long been identified as *B. straminea* under the working assumption that there was only a single, highly variable species, although some workers recognized a species complex was likely involved. Perkins (1913) noted that "*Bactra straminea* is a very widely distributed species in the islands and extremely variable, examples differing greatly in size and pattern. It is likely that several species are included under this name, for we have observed scores of specimens in some localities, without remarking any special variability. If there is only one species, then the variation is to a large extent local or racial. Melanochroic forms occur and these are sometimes of gigantic size." We now recognize that these "melanochroic forms" are actually one, and perhaps more than one, distinct species.

It is unclear why females of *B. omoomoo* are so rare in collections. They may be only weakly attracted to light or may not fly far from their host plant.

Conservation Status. *Bactra omoomoo* is likely secure. This species is common, sometimes even abundant, on wind-swept summit ridges in the Ko'olau mountains wherever 'uki (*Machaerina angustifolia*) grows. It is worth noting, however, that it is no longer found at some of the lower elevation spots at which it was first collected suggesting that even relatively widespread species disappear from urbanized areas over time.

Eccoptocera kualii, sp. nov.

Figs. 1G, H; 4A; 7D

Diagnosis. *Eccoptocera kualii* (O'ahu) is most similar to *E. foetorivorans* (Butler), the most common and widespread species of *Eccoptocera* on O'ahu. Males can be distinguished most easily by the strongly red-washed forewings (gray or black in *E. foetorivorans*), the rounded uncus (triangular in *E. foetorivorans*), and the much shorter apicoterminal extension of the phallus (dramatically longer in *E. foetorivorans*). Females can most reliably be distinguished by the conspicuous, complete median fascia (incomplete in *E. foetorivorans*), and the presence of a triangular, tooth-like process obscuring a portion of the ostium (this process absent or only weakly developed in *E. foetorivorans*).

Type material. Holotype: O'ahu: ♂, Mokulē'ia F[orest] R[eserve], nr. Nike Greenhouse; 21.5456, –158.1950; 610 m; 19 ii 2023; K.A. Austin et al.; UVLED light sheet / DNA extraction KA0750 / KAA diss. #0980 (UHIM). **Paratypes** (2♂♂, 2♀♀). O'ahu: 1♂, 1♀, same data as holotype / DNA extractions KA0749, KA0751 / KAA diss. #0979 (♀), #0981 (♂) (UHIM). 1♀, Mokulē'ia F[orest] R[eserve], in gulch nr. Pahole N[atural] A[rea] R[eserve]; 21.5439, -158.1883; 460 m; 19–20 ii 2023; K. A. Austin; UV bucket trap / DNA extraction KA0755 / KAA diss. #0985 (UHIM). 1♂, Pahole N[atural] A[rea] R[eserve], Mokulē'ia Trail; 21.5371, -158.1806; 637 m; 30 ix – 1 x 2022; K. A. Austin, S. Schachat, T. Lendt, T. Smith; UV bucket trap / DNA extraction 0660 / KAA diss. #0895 (UHIM).

Description. Male (n=3). ***Head.*** Scales on frons long, erect, pale whitish-brown on ventral half, dark brown on dorsal half; vertex with medial scales pale whitish-brown or silver, reddish-brown laterally; labial palpus approximately 2× width of compound eye, lateral scaling dark brown, scaling on second segment greatly expanded; medial surface with scaling pale gray, terminal segment dark brown. Ocellus moderate, nearly confluent with compound eye. Scape pale reddish-brown to dark brown; antennal notch present; sensillae minute, scarcely extending beyond scaling; dorsal scales of flagellum concolorous with scape. ***Thorax.*** Dorsum with scaling on anterior

half silver-gray, scaling on posterior half dark brown or reddish-brown; tegulae intermixed with reddish-brown, dark brown, or silver scales, typically darker at base. Lateral surface of foreleg and midleg with scaling dark brown to black, femur often reddish-brown, tarsi ringed with silver scales; hindleg similar but paler. Dorsal surface of FW (Fig. 1G; FWL: 5.4–5.7 mm) with costal fold extending from wing base to approximately 0.55× FW length; ground color reddish-brown or dark brown to black, scaling above costal fold especially reddish, remainder of wing heavily overlaid with grayish-silver strigulae; strigulae fairly distinct, basal strigulae silver-gray, triangular or nearly so, terminating at 0.33× costal fold; median strigulae comprised of two pairs of broad, oblique, parallel-sided bands extending from approximately 0.5× inner margin, parallel with termen, often obscured on medial margin before reaching costal strigulae; distal margin of median strigulae fused to medial margin of ocelloid patch near end of cell; ocelloid patch with three narrow black streaks; four pairs of costal strigulae present, the distal three pairs white or silver, the basal pair beyond end of costal fold often nearly concolorous with ground color, obscure; small subapical notch present along termen; fringe with scales black, occasionally with reddish-brown scales, often with extreme tip of these scales pale gray. Ventral surface of FW entirely brown except for small patches of pale gray or white scales at costal strigulae. Dorsal surface of HW brown; cubital pecten well-developed; anal region with small extension. Ventral surface of HW pale brown. ***Abdomen.*** Vestiture of abdomen grayish-brown. Genitalia (Fig. 4A) with uncus short, narrowed on posteromedial surface, terminally rounded, slightly inflated apically, with minute, posterior rounded process (often obscured in slide-mounted specimens); socius weakly developed, flaplike, with a patch of short, dense setae; tegumen arched, with long setae present over lateral surface; gnathos present as a pair of triangular lobes and a pair of weakly sclerotized narrow arms; valva long, slender, swollen at base with large, subtriangular basal excavation, neck of valva strongly constricted, sacculus sinuate, cucullus well developed, with large ventroterminal spine-like process; valvae asymmetrical, with right cucullus longer, more strongly curved; juxta triangular, with district medial ridge; caulis long, well developed, fused to anellus; phallus robust, swollen basally, broad, with short, upcurved apical extension; vesica with a dense patch of long, thin, deciduous, spine-like cornuti.

Female (n=2). ***Head.*** Similar to male except without reddish scaling on vertex, antenna without antennal notch. ***Thorax.*** Similar to male except larger (Fig. 1H; FWL: 6.2–6.4 mm), without any semblance of reddish scaling on dorsum or dorsal surface of FW, two additional pairs of pale dorsal strigulae along basal half of costa; costal fold, anal extension absent. ***Abdomen.*** Vestiture of abdomen similar to male. Genitalia (Fig. 7D) with papillae anales broad, subtriangular, apically acute, with shallow anteromedial excavation, flattened and evenly roughened on ventral surface**;** apophyses anteriores and posteriores approximately 0.5× length of S7; sterigma broad, semicircular; ostium elliptical; right side of lamella antevagenalis modified into a distinct, broad triangular process partially obscuring the ostium; ductus bursae short, relatively broad, with a short, membranous basal extension; colliculum present, well sclerotized, ring-like, incomplete; base of ductus bursae well-sclerotized, this sclerotization extending to ductus seminalis or just beyond, with a pair of parallel-side ridge-like processes

on interior wall of the dorsal side; interior of corpus bursae with a pair of narrow, parallel, weakly sclerotized ridge-like processes extending from base of corpus bursae to approximately 0.25× length of corpus bursae on dorsal wall, terminating in a large, lightly sclerotized patch; corpus bursae with two well developed, opposed, thorn like signa, one situated in the middle of the sclerotized patch and the other situated opposite of it on the ventral wall; corpus bursae globose, inner surface evenly covered in minute spinules.

Biology. The biology for *Eccoptocera kualii* is unknown, but we suspect it feeds as a leaf-tier on *Metrosideros* spp. or *Syzygium sandwicense* like other species of Hawaiian *Eccoptocera*. Only ʻōhiʻa lehua (*Metrosideros polymorpha*) was observed in the immediate vicinity of the collecting localities for this species.

Distribution. *Eccoptocera kualii* is exclusively found in Pahole Natural Area Reserve and the surrounding area of Mokulēʻia Forest Reserve in the northern Waiʻanae Mountains where it is known from 460–637 meters elevation.

Etymology. From Hawaiian "kualiʻi," meaning a dwarfed plant or animal, referring to the size of this species, which is smaller than all other species of *Eccoptocera* except the enigmatic *E. osteomelesana* (Swezey) (Austin and Rubinoff 2023).

Conservation Status. *Eccoptocera kualii* is likely endangered. Despite numerous island-wide surveys for *Eccoptocera* on Oʻahu, *Eccoptocera kualii* is only known from three localities in a small portion of the northern Waiʻanae Mountains separated by just 1.1 miles. Its hypothesized host plant (*Metrosideros polymorpha*) is still widespread and common in the Waiʻanae Mountains, so it is unclear if some other factor is limiting its range, our hypothesis of host plant is inaccurate, or if it is naturally restricted to such a small area. Rapid ʻŌhiʻa Death, a fungal disease caused by two species of *Ceratocystis*, is a burgeoning threat to all ʻōhiʻa forests in the Hawaiian Islands and poses a major risk to *Eccoptocera kualii* and most other species of *Eccoptocera* in Hawaiʻi.

Eccoptocera iwipookua, sp. nov.

Figs. 1I–L, 4B, 7E

Diagnosis. *Eccoptocera iwipookua* (Kauaʻi) is superficially most similar to *E. ohiaha* (Oʻahu) but can be distinguished by its slightly larger size (FWL: 7.2–7.7 in *E. iwipookua* males, 7.0–7.4 mm in *E. ohiaha* males; 7.4–8.5 in *E. iwipookua* females, 5.6–7.7 in *E. ohiaha* females). However, it may be necessary to examine the genitalia to obtain a positive identification. Males of *E. iwipookua* have an extremely short, downcurved apicoterminal extension of the phallus (this structure very long and upcurved in *E. ohiaha*). Females of *E. iwipookua* lack the membranous basal extension of the ductus bursae and the long, finger-like process obscuring the ostium found in *E. ohiaha*.

Type material. Holotype: Kauaʻi: 1♂, Nā Pali-Kona F[orest] R[eserve], Alakaʻi Wilderness Preserve, S of Wai[a]koali Bog 1; 22.1292, -159.5782; 1260m; 12–14 vii 2023; K. A. Austin et al.; UVLED light sheet / DNA extraction KA0880 / KAA diss. #1105 (UHIM). **Paratypes** (15♂♂, 6♀). Kauaʻi: 1♂, 1♀, same data as holotype / DNA extractions KA0879 / KAA diss. #1104 (♀) (UHIM). 7♂♂, 1♀, Nā Pali-Kona F[orest] R[eserve], Alakaʻi Wilderness Preserve, NE of Wai[a]koali Bog 1; 22.1300, -159.5774; 1260m; 12–13 vii 2023; K. A. Austin; [UV] bucket trap / DNA extractions KA0878, KA0881, KA0882 / KAA diss. #1103 (♀), #1106 (♂), #1107 (♂) (UHIM). 2♀♀, same as previous except N of Wai[a]koali Bog 1; 22.1300, -159.5780; 1265m (UHIM). 2♂♂, Nā Pali-Kona Forest Reserve,

Alaka‘i Wild[erness] Pres[erve]; edge of Waiakoali Bog 1; 22.1294, -159.5775; 1260m; 8–10 ii 2022; K. A. Austin; UVLED light sheet / DNA extractions KA0440, KA0441 / KAA diss. #0697, #0698 (UHIM). 1♀, Nā Pali-Kona F[orest] R[eserve], Alaka‘i Swamp Trail; 22.1391, -159.62442; 1160m; 16–17 iii 2024; K. A. Austin, G. Talaber; UV bucket trap / DNA extraction KA1155/ KAA diss. #1201 (UHIM). 1♂, 1♀, Kahōluamanu; iv 1920 / J. A. Kusche / slide Z-I-16-65-B (♂) (BPBM). 2♂♂, Mts.; 3-4000 ft [x m]; vi 1894; Perkins (BPBM). 2♂♂, Kahōluamanu; 4000 ft [x m]; iv 1895; Perkins (BPBM).

Description. Male (n=16). ***Head.*** Scales on frons with long, erect, pale brown scales on dorsal half, dark brown or black medially and laterally; scaling on vertex pale brown to brown, often gray medially; labial palpus approximately 2× width of compound eye, lateral scaling dark brown or black, often with a small, conspicuous patch of gray scales in the middle of the second segment, scaling on second segment greatly expanded; medial surface pale gray or white. Ocellus moderate, scarcely separated from compound eye. Scape dark brown, pale gray or silver at base; antennal notch present; sensillae short, approximately 0.5× width of flagellomere; dorsal scales of flagellum entirely dark brown. ***Thorax.*** Dorsum with scaling silver, with a pair of large dark brown lateral patches and an inverted V-shaped posterior mark, a dark brown medial line often present; tegulae dark brown or black, often with scattered warm orange-red or silver scales. Lateral surface of foreleg dark brown or black, occasionally with silver scales at joints; midleg and hindleg dark brown, often with more extensive silver scaling, especially at joints and along tarsi. Dorsal surface of FW (Figs 1I, J; FWL: 7.2–7.7 mm) with costal fold to approximately 0.55× FW length; ground color dark brown or black; dorsal strigulae light gray or white, incomplete and heavily fractured; basal strigulae incomplete, typically only present as a short pair of parallel bars at the base of the inner margin; median strigulae similarly irregular, often fractured, occasionally complete, forming a 90° bend at base of cell to reach near the base of costa; subterminal fasciae distinct to end of cell; ocelloid patch formed by 2-3 small circular patches of silver scales on the distal and proximal margin and 3-4 short black streaks on the distal half (rarely one of these streaks may be longer, nearly reaching the proximal margin); four pairs of costal strigulae present, with variable development of white scaling; small subapical notch present along termen; fringe variable, with black, white, and gray scales typically all present to some degree. Ventral surface of FW brown, small patches of pale gray or white scales along costal strigulae. Dorsal surface of HW entirely brown, cubital pecten well-developed; anal region with small extension. Ventral surface of HW pale brown. ***Abdomen.*** Vestiture of abdomen grayish-brown, terminal segments slightly paler. Genitalia (Fig. 4B) with uncus with a short neck and a broad, evenly rounded, semicircular apex; socius weakly developed, reduced to a slightly elevated patch of long, hair-like setae; tegumen high, arching, with long, hair-like setae over entire lateral surface; gnathos present as a pair of subtriangular lobes and a pair of narrow, weakly sclerotized arms; valvae long, slender, highly sinuous, asymmetrical; base of valvae swollen, with a large subtriangular or semicircular basal excavation; neck of valva constricted; cucullus well developed, with a large, sharp, ventroterminal spine-like process; right valva longer, more sinuous than left valva; juxta triangular; caulis long, fused to anellus; phallus robust, short, swollen at

base, with short, downcurved, acute apical extension; vesica with a dense patch of long, thin, deciduous, spine-like cornuti.

Female (n=6). ***Head.*** Similar to male except occasionally with more extensive silver or gray scaling on frons; antenna without antennal notch, sensillae minute. ***Thorax.*** Similar to male except larger (Figs 1K, L; FWL: 7.4–8.5 mm), with much more extensive white and silver scaling, especially along inner margin and basal half of costa; costal fold, anal extension absent or occasionally weakly-developed. ***Abdomen.*** Vestiture of abdomen similar to male. Genitalia (Fig. 7E) with papillae anales broad, subtriangular, with shallow anteromedial excavation, ventral surface roughened; apophyses posteriores approximately 0.5× length of S7; apophyses posteriores approximately 0.67× length of S7; sterigma broad, bowl-shaped, distal edge slightly thickened; ostium circular, right side of lamella antevaginalis slightly thickened, but without obscuring ostium; ductus bursae short, without basal extension; colliculum present, well-developed, ring-like, but incomplete on dorsal side; basal half of ductus bursae highly sclerotized, extending to base of ductus seminalis; corpus bursae large, globular, with a pair of narrow, parallel, sclerotized, ridge-like processes extending from base of corpus bursae to approximately 0.25× length of corpus bursae on dorsal wall; a large, weakly sclerotized patch present on the dorsal wall of the corpus bursae; two large, thorn like signa present, one at the center of the sclerotized patch and the other situated opposite of it on the ventral wall; inner surface of corpus bursae evenly covered in minute spinules.

Biology. The biology for *Eccoptocera iwipookua* is unknown, we hypothesize that it feeds as a leaf-tier on *Metrosideros* spp. or *Syzygium sandwicense* like other species of Hawaiian *Eccoptocera*. Both ʻōhiʻa lehua (*Metrosideros polymorpha*) and ʻōhiʻa hā (*Syzygium sandwicense*) were commonly observed in the immediate vicinity of all known collecting localities for this species.

Distribution. This species is known from two localities: around Waiakoali Bogs 1 and 2 and along the Alakaʻi Swamp Trail at elevations ranging from 1160–1265 meters. These two localities are separated by approximately 3.2 miles.

Etymology. From Hawaiian "iwi poʻo," meaning "skull" and "kua," meaning "back," referring to the skull-like pattern on the thorax of this species.

Comments. This species was listed as "*Eccoptocera* new species 9" by Zimmerman (1978).

Conservation Status. *Eccoptocera iwipookua* is likely secure. Despite *E. iwipookua* being known from only two modern collecting localities, suitable habitat exists elsewhere at higher elevations on Kauaʻi but remains difficult to access for entomological surveys. Additional surveys are needed to better characterize this species' distribution, host plant(s), and habitat requirements.

***Eccoptocera kukona*, sp. nov.**

Figs. 1M–P; 4C, 7F, 9B

Diagnosis. *Eccoptocera kukona* (Kauaʻi) is most similar to *E. foetorivorans* (Butler), which is not known from Kauaʻi and averages slightly smaller (FWL 6.3–7.7 in *E. kukona*, 4.2–7.1 mm in *E. foetorivorans*). Males can be distinguished most easily by their red-orange tegulae (dark brown or gray in some specimens), and rounded uncus (triangular in *E. foetorivorans*). Females are exceedingly similar to *E. foetorivorans*, but are typically darker, with less contrasting coloration on the forewing, often with mahogany or orange scales throughout. There is a conspicuous cup-like cavity on the left side of the ostium of *E. kukona*

(this structure is absent or only weakly developed in *E. foetorivorans*), but it is easily obscured in slide-mounted or inadequately stained genitalia preparations.

Type material. Holotype: Kaua'i: ♂, Nā Pali-Kona F[orest] R[eserve], Alaka'i Wilderness Preserve, Mōhihi-Wai'alae Trail; 22.1159, -159.6010; 1080m; 16 iii 2024; K. A. Austin, G. Talaber; UVLED light sheet / DNA extraction KA1148 / KAA diss. #1194 (UHIM). **Paratypes** (69♂♂, 67♀♀). Kaua'i: 3♂♂, 11♀♀, same data as holotype / DNA extractions KA1145, KA1146, KA1147 / KAA diss. #1191(♀), #1192(♀), #1193(♀). 7♂♂, 4♀♀, Nā Pali-Kona F[orest] R[eserve], Alaka'i Swamp Trail; 22.1391, –159.62442; 1160m; 16–17 iii 2024; K. A. Austin, G. Talaber; UV bucket trap / DNA extractions KA1150, KA1151, KA1152, KA1153 / KAA diss. #1196(♂), #1197(♀), #1198(♀), #1199(♀) (UHIM). 7♂♂, Nā Pali-Kona F[orest] R[eserve], Mākaha Valley; 22.1211, -159.6855; 920m; 16–17 iii 2024; K. A. Austin, G. Talaber; UV bucket trap / DNA extraction KA1154 / KAA diss. #1200 (UHIM). 3♂♂, 2♀♀, Nā Pali-Kona F[orest] R[eserve], Alaka'i Wilderness Preserve, Wai'alae Cabin; 22.0826, -159.5855; 1110m; 21–23 ii 2024; K. A. Austin; UVLED light sheet / DNA extractions KA0981, KA0982, KA0983, KA0984, KA0985 / KAA diss. #1174(♀), #1175(♀), #1176(♂), #1177(♂), #1178(♂) (UHIM). 1♀, Nā Pali-Kona F[orest] R[eserve], Pu'ukī-Wai'alae Trail, 0.5 mi S of Wai'alae Cabin; 22.0777, -159.5876; 1120m; 21–22 ii 2024; K. A. Austin; UV bucket trap / DNA extraction KA0980 / KAA diss. #1173 (UHIM). 4♂♂, 12♀♀, Nā Pali-Kona F[orest] R[eserve], Alaka'i Wilderness Preserve, S of Wai[a]koali Bog 1; 22.1292, -159.5782; 1260m; 12–14 vii 2023; K. A. Austin et al.; UVLED light sheet / DNA extractions KA0870, KA0871, KA0872, KA0873, KA0875, KA0876, KA0877(♂) / KAA diss. #1095(♀), #1096(♀), #1097(♀), #1098(♀), #1100(♂), #1101(♂), #1102(♂). 3♂♂, 5♀♀, Nā Pali-Kona F[orest] R[eserve], Alaka'i Wilderness Preserve, Wai[a]koali Bog 1; 22.1297, -159.5780; 1265m; 13–14 vii 2023; K. A. Austin; [UV] bucket trap (UHIM). 6♂♂, 7♀♀, Nā Pali-Kona F[orest] R[eserve], Alaka'i Wilderness Preserve, N of Wai[a]koali Bog 1; 22.1300, -159.5780; 1265m; 12–13 vii 2023; K. A. Austin; [UV] bucket trap (UHIM). 13♂♂, 11♀♀, Nā Pali-Kona F[orest] R[eserve], Alaka'i Wilderness Preserve, NE of Wai[a]koali Bog 1; 22.1300, -159.5774; 1260m; 12–13 vii 2023; K. A. Austin; [UV] bucket trap (UHIM). 1♂, Nā Pali-Kona Forest Reserve, Alaka'i Wild[erness] Pres[erve]; edge of Waiakoali Bog 1; 22.1294, -159.5775; 1260m; 8–10 ii 2022; K. A. Austin; UVLED light sheet / DNA extraction KA0439 / KAA diss. #0696 (UHIM). 1♀, Kōke'e State Park, Awa'awapuhi Trail; 22.1428, -159.6538; 1235m; 11 vii 2023; K. A. Austin; UVLED light sheet / DNA extraction 0874 / KAA diss. #1099 (UHIM). 3♂♂, Kōke'e State Park, Honopu Trail; 22.1466, -159.6504; 1250m; 23–24 iii 2022; K. A. Austin; [UV] bucket trap / DNA extractions KA0485, KA0486, KA0487 / KAA diss. #0730, #0731, #0732 (UHIM). 3♂♂, Halele'a F[orest] R[eserve], Upper Hanalei Valley, along Hanalei River; 22.1007, -159.4661; 285m; 26–27 v 2022; K. A. Austin, J. B. Reil; [UV] bucket trap / DNA extractions KA0575, KA0576 / KAA diss. #0800, #0801 (UHIM). 1♀, same as previous except 22.1018, -159.4647; 265m; UVLED light sheet / DNA extraction KA0574 / KAA diss. #0799 (UHIM). 13♂♂, 11♀♀, Alaka'i Swamp, 159° 37' W, 22° 9' N [22.1500, -159.6167]; [large range of dates from 3 xi 1998 – 8 ix 2000]; / M. L. Henneman; ex. Metrosideros polymorpha (BPBM). 1♂, Alaka'i Swamp, 159° 37' W, 22° 8'

N [22.1333, -159.6167]; 13 x 1998; M. L. Henneman / ex. Metrosideros polymorpha (BPBM). 1♂, same as previous except 10 viii 1999; G. Hatt, A. Orne (BPBM). 1♂, Alaka'i Swamp, 159° 37' W, 22° 8–9' N [22.1500–22.1333, -159.6167]; 1 vi 1999; M. L. Henneman (BPBM). 1♀, same as previous except 9 viii 1999 (BPBM).

Description. Male (n=70). ***Head.*** Scales on frons with long, erect, dark brown scales on dorsal half, occasionally with short gray scales laterally; scaling on vertex long, dense, dark brown, often with apices ashy gray, especially medially, giving the head a strongly frosty appearance; labial palpus with scaling dark brown, often with scattered gray scales, especially at dorsal base of second segment; second segment with scaling greatly expanded; terminal segment rarely with reddish-orange scales; medial surface pale gray. Ocellus separated from compound eye by less than 0.5× of ocellus, nearly confluent in some specimens. Scape with scaling dark brown, often heavily intermixed with gray scales; antennal notch present; sensillae short, no more than 0.5× width of flagellomere; dorsal scales of flagellum dark brown. ***Thorax.*** Dorsum with scaling silver or gray, occasionally with dark brown patches laterally, rarely with a large dark brown patch at posterior margin; tegulae with scaling dark brown at base, often with reddish-orange scales at apex, occasionally entirely gray or dark brown. Lateral surface of foreleg with scaling dark brown, often with apices of scales gray, tarsi ringed with gray; midleg and hindleg with femur paler, remainder of leg only rarely with bicolored scales. Dorsal surface of FW (Fig. 1M; FWL: 6.3–7.6 mm) with costal fold to approximately 0.55× FW length; ground color dark brown to black, often with intermixed reddish-orange scales; dorsal strigulae variably developed, most often white or light gray, but occasionally darker gray or nearly obscured, often entirely shaded between with nearly concolorous light gray, less commonly well-separated with darker scales; basal strigulae typically only present as a small gray patch of scales near the base of inner margin; median strigulae variably developed, often present as a small triangular patch of gray scales, rarely extending onto costal fold, where it can be gray or reddish-orange; subterminal fasciae well-developed, broad, parallel-sided, complete to near end of cell. Ocelloid patch composed of 5-6 silver patches of varying size in a U-shaped arrangement on a variable field of black, gray, white, or red field; open on the costal half; with 3 short black streaks on the inner surface of the distal margin. Four pairs of costal strigulae present, white, but often heavily obscured by metallic blue-gray scaling such that very little white is visible. Small subapical notch present along termen; fringe variable, most often gray or black scales, apices white. Ventral surface of FW brown, small patches of pale gray or white present at costal strigulae, but often faint, typically only terminal pair visible. Dorsal surface of HW entirely brown, paler basally; cubital pecten well-developed; anal region with a small extension. Ventral surface of HW pale brown. ***Abdomen.*** Vestiture of abdomen grayish-brown. Genitalia (Fig. 4C) with uncus with a short neck and a broad, slightly inflated, rounded apex; socius present as a slightly elevated patch bearing moderately long, hair-like setae; tegumen high, arching, with long, hair-like setae on lateral surface; gnathos present as a pair of triangular lobes and a pair of weakly sclerotized, thin arms; valvae slender, curved, asymmetrical; base of valvae swollen, with a large subtriangular basal excavation; neck of valvae slightly constricted; cucullus well-developed, with a small dorsal, mound-like inflation; apex

of cucullus with a large, sharp, ventrally directed spike-like process; right valva slightly longer, more curved than left valva; juxta broad, triangular; caulis long, fused to anellus phallus robust, slightly irregular and swollen at base, with long, upcurved apical extension; vesica with a dense patch of long, thin, deciduous, spine-like cornuti.

Female (n=67). ***Head.*** Similar to male except antenna without antennal notch. ***Thorax.*** Similar to male except slightly larger (Figs 1N–P; FWL: 6.5–7.7 mm), more variable in wing pattern, often with much more extensive reddish-orange ground color and metallic blue-gray scaling on costal strigulae; costal fold, anal extension absent. ***Abdomen.*** Vestiture of abdomen similar to male. Genitalia (Fig. 7F) with papillae anales subtriangular, apically broad, acute, with shallow anteromedial notch, flattened and roughened on ventral surface; apophyses posteriores approximately 0.5× length of S7; apophyses posteriores approximately 0.67× length of S7; sterigma rectangular, widening slightly posteriorly; ostium elliptical; right side of lamella antevagenalis without any modified structure obscuring the ostium, but may occasionally be slightly thickened, left side of ostium with conspicuous, small, cup-like cavity; ductus bursae short, with a long membranous extension (in some well-stained genitalia preparations this extension appears to be slightly sclerotized on the interior wall); colliculum present, well sclerotized, ring-like, incomplete on ventral side; ductus bursae broad, basal half well-sclerotized to ductus seminalis; corpus burse globose, with a pair of parallel, ridge-like processes present on interior dorsal wall; a large, circular sclerotized patch present on the dorsal wall of corpus bursae; two large, opposite, thorn-like signa present on the dorsal and ventral walls; inner surface of corpus bursae densely covered in a fine network of minute spinules.

Biology. *Eccoptocera kukona* has been reared from tied leaves of ʻōhiʻa lehua (*Metrosideros polymorpha*; Myrtaceae).

Distribution. *Eccoptocera kukona* is the most widespread and common species of *Eccoptocera* on Kauaʻi, where it can be found in virtually all places where its host, ʻōhiʻa lehua (*Metrosideros polymorpha*), grows. It has been collected at elevations from 265–1265m in lowland wet forest, mid-elevation mesic forest, and high elevation wet forest and bogs.

Etymology. This species is named in honor of Kūkona, one of the signature chiefs of ancient Kauaʻi and the father of the most well-known Kauaʻi chief, Manokalanipō.

Comments. This species was listed as "*Eccoptocera* new species 1" by Zimmerman (1978).

Conservation Status. *Eccoptocera kukona* is likely secure. It is widespread and common, sometimes even abundant in native forest wherever ʻōhiʻa lehua (*Metrosideros polymorpha*) occurs.

***Panaphelix nalowale*, sp. nov.**

Figs. 2A; 5A

Diagnosis. *Panapehlix nalowale* (Oʻahu) is most similar to *P. kikokea* (Maui) but can be distinguished by its smaller size, pale brown forewing color and wide, conspicuous antemedian interfascia.

Type material. Holotype: Oʻahu: ♂, Mokulēʻia, Pahole; xii [19]74; S. L. Montgomery / KAA diss. #0420 (BPBM).

Description. Male (n=1). ***Head.*** Scales on frons long, erect, pale brown, with scattered pale yellow scales; scales on vertex pale yellow; labial palpus approximately 2× width of compound eye, scales on lateral surface entirely pale brown, second segment with scaling greatly expanded dorsally; medial surface

with scaling pale yellow at base, pale brown apically. Ocellus moderate, separated from compound eye by approximately width of ocellus. Scape with scaling pale brown; flagellum strongly bipectinate; ramus approximately 3× width of flagellomere, unscaled; sensillae short, approximately 0.1× length of ramus; dorsal scales of flagellum alternating between rows of pale brown and pale yellow for flagellomeres 1–5, entirely pale brown beyond (antennae broken beyond flagellomere 13 and 15 in left and right antenna, respectively). ***Thorax.*** Dorsum with scaling pale yellow, dorsal tuft pale brown; tegulae pale yellow at base, pale brown apically. Lateral surface of foreleg and midleg with scaling pale brown, tarsal segments ringed with pale yellow at apices; hindleg scaling entirely pale yellow except for a small patch of pale brown scales present on apical half of tibia. Dorsal surface of FW (Fig. 2A; FWL: 8.4 mm) with ground color brown; pale brown scales present at extreme base and distal half of costa; antemedian interfascia broad, well-defined, widened into a near-perfect circle medially, bordered with black scales, filled with pale brown scales at costa and inner margin; white scales present medially; a small black dot present at end of cell and a small black-ringed scale present just beyond, filled with pale brown scales; fringe pale brown, slightly darker at apex; costal fold absent. Ventral surface of FW brown, patches of pale brown scaling present along costa, mirroring pale scaling on dorsal surface. Dorsal surface of HW dirty white at base, pale brown apically, heavily suffused with brown strigulae. Ventral surface of HW concolorous with dorsal surface of HW, but slightly paler. ***Abdomen.*** Vestiture of abdomen entirely brown. Genitalia (Fig. 5A) with uncus slender, apically swollen, shallowly cleft, nearly heart-shaped, with moderate, hair-like setae on apicoventral surface; socii absent; arms of gnathos moderate, fused beyond 0.5×, distinctly forked at apex; tegumen high, somewhat slender, without significant modifications; transtilla broad, ribbon-like; valva broad, subcircular, membranous; sacculus well-developed, highly sclerotized, with broad, somewhat rounded, extension beyond apex; juxta large, broad, plate-like, with distinct medial groove; phallus short, squat, slightly downcurved; caulis obsolete; vesica without observed cornuti or sockets.

Female (n=0). Female unknown.

Biology. This species is possibly a leaf-tier on *Melicope* spp. The only known host for *Panaphelix* is alani (*Melicope clusiifolia*; Rutaceae) for the Maui species *P. marmorata* Walsingham.

Distribution. *Panaphelix nalowale* is known from a single specimen collected in what is now Pahole Natural Area Reserve in the northern Wai‘anae Mountains. If still extant, it should be sought in similar native-dominated mesic forest elsewhere in the Wai‘anae Mountains wherever its likely host plant, *Melicope*, occurs.

Etymology. From Hawaiian “nalowale,” meaning “vanished” or “extinct,” referring to the likely extinct status of this new species.

Conservation Status. *Panaphelix nalowale* is likely critically endangered or extinct. It is only known from a single specimen collected 50 years ago and has not been seen since, despite Pahole Natural Area Reserve being one of the most well-surveyed sites for moths in the Wai‘anae Mountains. However, two possible host plants of this species, *Melicope sandwicensis* and *M. oahuensis* are still extant in the area, but very rare (DLNR-DOFAW 2017, OANRP 2018). We have not surveyed in their vicinity, giving some hope that if these plants are located, this species may still be found to persist.

Panaphelix mapala sp. nov.

Figs. 2B, C; 5B; 8A

Diagnosis. *Panaphelix mapala* (Hawai‘i) is most similar to *P. marmorata* Walsingham (Maui) but can be distinguished by its smaller size (10.3–12.5 mm in *P. mapala*, 11.5–15.4 mm in *P. marmorata*). Male genitalia of *P. mapala* have an apically split uncus with a deep medial groove, a character present in *P. marmorata* only as a shallow notch. Female genitalia are exceedingly similar, but the females of *P. mapala* lack the yellow form that is present in many populations of *P. marmorata*.

Type material. Holotype: Hawai‘i: ♂, Pu‘u O Umi N[atural] A[rea] R[eserve], above Waiakamali Gulch; 20.0709, -155.7228; 1485m; 1–2 viii 2023; K. A. Austin, D. Rubinoff; [UV] bucket trap / DNA extraction KA0895 / KAA diss. #1121 (UHIM). **Paratypes** (6♂♂, 3♀♀): Hawai‘i: 1♂, Kohala Mt.; 3,800 ft [1158 m]; 29 x [19]94 (UHIM). 1♂, Kohala Mts., Kawaihae 2; 4960 ft [1512 m]; 9 xii [20]07 (UHIM). 1♀, Kohala F[orest] R[eserve], Ditch Access Rd.; 3920 ft [1195 m]; 9 iii [20]07 (UHIM). 1♀, Pu‘u O Umi N[atural] A[rea] R[eserve], Mauga [Mauka?] Cabin; 4500 ft [1372 m]; 27 ix [19]99; N. Agorastos (UHIM). 1♂, Hilo Watershed, Red Lepo Road; 3600 ft [1098 m]; 26 ix [19]98 (UHIM). 1♂, same data as previous except 6 iv [19]99; J. Giffin (UHIM). 1♂, Hakalau N[ational] W[ildlife] R[efuge], Maulua; 1312 m; 19°52’58.26”N, 155°16’29.1”W [19.8829, -155.2748]; 15 ii 1999; D. A. LaPointe; UV light; ‘ōhi‘a/‘ōlapa wet forest (UHIM). 1♀, So[uth] Kona For[est] Res[erve], Kukuiopa‘e Sec[tion]; 5000 ft [1524 m]; 26 iv [20]00; J. Giffin (UHIM). 1♂, Pu‘u Maka‘ala N[atural] A[rea] R[eserve], Kulani Sect[ion], along road [at] border of n[orth] b[ou]nd[a]ry and boy’s school units; 1800 m; 19.59053, -155.34227; 21 x 2011; UV light tr[a]p; W. Haines; koa forest / DNA extraction KA0057 / KAA diss. #0336 (UHIM).

Description. Male (n=7). ***Head.*** Scales on frons short, yellow; dorsal half of frons additionally clothed in long, bright orange scales; vertex with scales bright orange, rarely with scattered yellow or brown scales; labial palpus porrect, approximately 2× width of compound eye, scales on lateral surface yellow on first segment, brown on second and third segments, often with scattered orange or yellow scales, especially apically; medial surface with scaling pale yellow. Ocellus moderate, separated from compound eye by approximately width of ocellus. Scape with scaling brown, occasionally with scattered orange scales; flagellum strongly bipectinate; ramus approximately 4× width of flagellomere, unscaled; sensillae short, approximately 0.1× length of ramus; dorsal scales of flagellum entirely brown for first seven segments, with alternating rows of brown and pale yellow scales beyond, becoming progressively more yellow apically. ***Thorax.*** Dorsum with scaling tricolored brown, yellow, and orange; brown often restricted to lateral and posterior margins, yellow to anterior margin, and orange scattered throughout and dominant; tegulae with scaling typically orange or yellow-orange at base, brown at apex. Lateral surface of foreleg and midleg entirely brown, sometimes reduced to pale yellow in worn individuals; tarsal segments faintly ringed with pale yellow at apices; hindlegs entirely pale yellow, rarely pale brown. Dorsal surface of FW (Fig. 2B; FWL: 10.3–12.5 mm) with ground color yellow, orange, or burnt orange; forewing heavily overlaid with an irregular network of broad, brown strigulae, leaving only portions of the ground colors exposed in a seemingly random fashion; a white comma- or semicircle-shaped patch of scales present at base of cell; veins

distinctly overlaid with fine brown or orange scales, especially apparent apically; fringe brown, sometimes with scattered orange scales; costal fold absent. Ventral surface of FW similar to dorsal surface but markings more well-defined. Dorsal surface of HW with a fine network of faint brown strigulae, these becoming denser and more intricate towards fringe and apex. Ventral surface of HW similar to dorsal surface, but more highly contrasting in color. ***Abdomen.*** Vestiture of abdomen pale brown, occasionally dirty white, often paler apically; darker brown on ventral surface. Genitalia (Fig. 5B) with uncus slender, only moderately widened at apex, deeply cleft, with short, hair-like setae present at apex; socii absent; arms of gnathos slender, fused at 0.9× length, but separate again and forked at apex; tegumen moderate, without any noticeable modification; transtilla very broad, membranous, ribbon-like; valva high, arching, circular, strongly plicate latitudinally; sacculus broad, well-sclerotized, with distinct thorn-like projection at apical margin; juxta large, plate-like, with shallow medial notch; phallus long, slender, slightly downcurved; caulis obsolete; vesica without observed cornuti or sockets.

Female (n=3). Similar to male except larger (Fig. 2C; FWL: 12.0–12.7 mm); with much more extensive orange coloration on head, thorax; antennae simple, sensillae minute; forewing with brown strigulae narrower, much less extensive, resulting in a much more orange forewing tone; without white patch of scales at base of cell on forewing; hindwing with brown strigulae much less dense, whiter overall. Genitalia (Fig. 8A) with papillae anales slender, closely situated at apex, evenly roughened on ventral surface; apophyses posteriores thin, approximately same length as S7; apophyses anteriores thin, approximately 0.8× length of S7; sterigma very thin, nearly obsolete; ostium similarly thin, ring-like; ductus bursae long, slender, of nearly uniform width throughout; ductus seminalis arising at arising at approximately 0.1× length of ductus bursae; corpus bursae moderate, circular; signum absent.

Biology. Although the host plant(s) for *P. mapala* is unknown, we strongly suspect it is a leaf-tier on alani (*Melicope* spp.), like its close relative *P. marmorata*. *Melicope* is a common understory component of the type locality of *P. mapala*, but no larvae were found during our limited time in the area.

Distribution. *Panaphelix mapala* is known from wet forests on the flanks of Kohala, Maunakea, Maunaloa, and Kīlauea volcanoes on Hawai‘i island between 1100 and 1800 meters elevation.

Etymology. From Hawaiian “māpala,” meaning “marble,” in reference to the Latin etymology of the very similar species *Panaphelix marmorata* Walsingham. “Marmor” is Latin for marble.

Conservation Status. *Panaphelix mapala* is likely secure. It has been found recently at several widely separated locations on Hawai‘i island and several species of *Melicope*, its presumed host plant, can still be commonly found in wet forests across Hawai‘i island.

Panaphelix kikokea sp. nov.

Figs. 2D; 5C

Diagnosis. *Panapehlix kikokea* (Maui) is most similar to *P. nalowale* (O‘ahu) but can be distinguished by its larger size, dark brown forewing color and obsolete antemedian interfascia, represented only by a large white dot at the base of the cell.

Type material. Holotype: Maui: ♂, Waikamoi Preserve, boardwalk; 20.7803, 156.2275; 1839m; 3–4 vi 2022; K.A. Austin, D. Rubinoff; [UV] bucket trap / DNA extraction KA0585 / KAA diss. #0810 (UHIM).

Description. Male (n=1). ***Head.*** Scales on frons short, sparse, pale brown to light yellow. Scales on vertex intermixed dark brown and golden brown. Labial palpus porrect, approximately 2× width of compound eye, scales on lateral surface entirely brown; medial surface straw yellow except for brown terminal segment. Ocellus moderate, separated from compound eye by approximately 1.5× width of ocellus. Scape with scaling dark brown; flagellum strongly bipectinate; ramus approximately 4× width of flagellomere; sensillae short, approximately 0.1× length of ramus; dorsal scales of flagellum dark brown on flagellomeres 1–2, with alternating rows of golden brown and dark brown rows of scales on remainder. ***Thorax.*** Dorsum with scaling heavily rubbed, but otherwise dark brown with intermixed light brown or golden brown scales; tegulae concolorous. Lateral surface of foreleg dark brown, apices of segments golden yellow; midlegs with apex of femur, base of tibia, tarsal segments dark brown, remainder golden yellow; hindlegs straw yellow, tarsal segments ringed with brown. Dorsal surface of FW (Fig. 2D; FWL: 10.2 mm) with ground color dark brown; scattered small patches of light brown scales present over entire forewing, especially apparent along costa; small circular patch of white scales present at base of cell, small black streak or spot distad of white patch; fringe brown and dark brown; costal fold absent. Dorsal surface of HW gray, densely overlaid with dark gray strigulae, finer strigulae present along towards fringe; fringe gray. Ventral surface of FW dark brown, costa light golden brown with small dark brown spots. Ventral surface of hindwing similar to dorsal surface, but more contrasting. ***Abdomen.*** Vestiture of abdomen dark gray; lateral surface, terminal segment dirty white. Genitalia (Fig. 5C) with uncus slender, apex moderately broad, cuneate, with shallow triangular medial cleft, with short, dense, hair-like setae on either side; socii absent; arms of gnathos long, slender, unclear whether fused at any point and forked at apex, or entirely separate; tegumen moderate, without any distinct modification; transtilla broad, membranous, band-like; valvae subtrapezoidal, strongly plicate latitudinally; sacculus well-developed, with a large, rounded, basal process and a minute apical extension; juxta large, quadrate, plate-like, dorsally rounded with a shallow medial excavation; phallus moderate, slender, downcurved; caulis obsolete; vesica without observed cornuti or sockets.

Female. Female unknown, but see Comments section below.

Biology. Unknown. *Panaphelix* may feed on alani (*Melicope* spp.) like another species of *Panaphelix* known from Maui, *P. marmorata* Walsingham, but confirmation is required.

Distribution. *Panaphelix kikokea* is known from a single specimen collected at The Nature Conservancy's Waikamoi Preserve at an elevation of 1839 meters. Similar habitat exists elsewhere on Maui and this species' range may be more widespread than currently known.

Etymology. From Hawaiian "kiko," meaning "dot" and "kea" meaning "white," referring to the conspicuous large, white dot at the base of the cell on the forewing.

Comments. Six female specimens that may be referable to *P. kikokea* are known from Maui (5) and Moloka'i (1). However, preliminary COI sequence data from the Moloka'i specimen suggest that at least that specimen may be distinct from *P. kikokea*. Unfortunately, we do not yet have any sequence data for Maui females. These six specimens are different enough externally from the holotype of *P. kikokea*

that they may represent the females of an undescribed species of *Panaphelix*.

Conservation status. Unknown. Similar habitat exists elsewhere at similar elevations on Maui, but the remote nature of the intact wet forests on the slopes of Haleakalā make surveys there difficult. More investigation is necessary to understand this species' conservation status and potential threats it faces.

Pararrhaptica huihui, sp. nov.

Figs. 2E, F; 6A; 8B, 9C

Diagnosis. *Pararrhaptica huihui* (Kaua'i) is very similar to *P. falerniana* (Walsingham) from Moloka'i, but tends to have more extensive, slightly paler blue-purple scales more diffusely scattered across the entire forewing, whereas *P. falerniana* tends to have darker blue-gray scaling more neatly and densely arranged in rows overlaid across the antemedian and postmedian interfascia and costal strigulae. Male genitalia can be distinguished from *P. falerniana* by the broader uncus of *P. huihui*. We have been unable to find characters in the female genitalia to readily distinguish the two species.

Type material. Holotype: Kaua'i: ♂, Nā Pali-Kona F[orest] R[eserve], Alaka'i Wilderness Preserve, S of Wai[a]koali Bog 1; 22.1292, -159.5782; 1260 m; 12–14 vii 2023; K. A. Austin et al.; UVLED light sheet / DNA extraction KA0855 / KAA diss. #1080 (UHIM). **Paratypes** (13♂♂, 1♀): Kaua'i: 2♂♂, same data as holotype / KA0856 / KAA diss. #1081 (UHIM). 6♂♂, Nā Pali-Kona F[orest] R[eserve], Alaka'i Wilderness Preserve, NE of Wai[a]koali Bog 1; 22.1300, -159.5774; 1260 m; 12–13 vii 2023; K. A. Austin; [UV] bucket trap (UHIM). 2♂♂, Nā Pali-Kona F[orest] R[eserve], Alaka'i Wilderness Preserve, N of Wai[a] koali Bog 1; 22.1300, -159.5780; 1265 m; 12–13 vii 2023; K. A. Austin; [UV] bucket trap (UHIM). 1♂, Nā Pali-Kona For[est] Res[erve], Alaka'i Wild[erness] Pres[erve], forest b[e]tw[ee]n Waiakoali Bogs 1&2; 22.1288, -159.5774; 1260 m; 9–10 ii 2022; K. A. Austin; [UV] bucket trap / DNA extraction KA0438 / KAA diss. #0695 (UHIM). 1♂, Nā Pali-Kona Forest Reserve, Mohihi Plateau; 22.1218, -159.5634; 1290 m; 11 v 2021; Melissa Simon; LED light sheet / DNA extraction KA0202 / KAA diss. #0498 (UHIM). 1♂, Nā Pali-Kona Forest Reserve, Waiakoali Headwaters; 22.1291, -159.5780; 1260 m; 20 v 2021; Melissa Simon, Kurt Ongman; LED light sheet / DNA extraction KA0231 / KAA diss. #0529 (UHIM). 1♀, Alaka'i Swamp, Kelekua Hut [Geo Bog]; 4520 ft [1378 m]; 19 ix 1973; K. and E. Sattler / KAA diss. #1223 (NHMUK).

Description. Male (n=14). ***Head.*** Scales on frons short, tightly appressed, dark gray to black, occasionally with white or pale gray scaling on ventral half, scattered pinkish scales present laterally; scales on vertex long, dark gray to black, with scattered pale orange scales; labial palpus slender, approximately 2× width of compound eye, distinctly curved with basal half upswept, apical half porrect; lateral surface with intermixed brick red and black scales, iridescent purple when viewed at an angle under magnification; medial surface with scales pale yellow. Ocellus separated from compound eye by approximately width of ocellus. Scape with scaling black and brick red; sensillae well-developed, approximately 1× width of flagellomere; dorsal scales of flagellum with alternating rows of black and brick red for basal ~10 flagellomeres, entirely black beyond. ***Thorax.*** Dorsum with scaling dark brown to black; tegulae concolorous. Lateral surface of foreleg dark brown to black, small patch of red-orange scales occasionally present at junction of femur-tibia, tarsal segments ringed with pale yellow scales; midlegs

similar to foreleg except without red scaling, pale yellow rings on tarsal segments more conspicuous; hindlegs with scaling pale brown to gray, scaling on tarsal segments similar to midlegs. Dorsal surface of FW (Fig. 2E; FWL: 7.6–8.7 mm) with ground color dark brown to black, heavily suffused with mahogany to brick red scaling along costa, pale brown along inner margin; antemedian interfascia present as a distinct, nearly straight pale brown running from 0.25× costa to 0.5× inner margin; entire forewing covered with scattered pale blue-purple or blue-gray scales, these scales forming distinct strigulae along distal half of costa and giving the entire moth a strongly iridescent purple color when viewed under light; fringe gray and pale orange; costal fold absent. Ventral surface of FW brown, lighter in patches along costa corresponding to strigulae on dorsal surface, iridescent purple when viewed at an angle under light. Ventral surface of HW concolorous with dorsal surface. ***Abdomen.*** Vestiture of abdomen gray to pale yellow. Genitalia (Fig. 6A) with uncus broad, quadrate, with long apicoventral hair-like setae; socii obsolete; tegumen moderate, without significant modifications; arms of gnathos well developed, apically fused, acute, but slightly rounded at apex; transtilla complete, thin, membranous, with small, minutely spined labides on lateral margin; valvae elongate, rounded apically, highly membranous, slightly upcurved, weakly plicate on ventral half, medial surface with long, hair-like setae; sacculus moderately wide, to approximately 0.25× length of valva, unmodified; juxta small, hexagonal, with broad dorsal notch; phallus pistol-shaped, acute at apex, produced; caulis minute; vesica with two extremely long, thin, basally fused cornuti in one specimen (the longer of the two cornuti approximately 0.5× length of phallus).

Female (n=1) Similar to male except larger (Fig. 2F; FWL: 10.4 mm), scaling on forewing and hindwing paler, more subdued, without distinct pale antemedian interfascia; strigulae along costa less well-defined; pale blue-purple scaling on forewing more evenly distributed. Genitalia (Fig. 8B) with papillae anales large, distally convex, evenly roughened on ventral surface; apophyses posteriores thin, straight, approximately 0.5× length of S7; apophyses anteriores similarly shaped, approximately same length as S7; sterigma thin, weakly developed; ostium U-shaped, slightly inflated, membranous; ductus bursae long, slender, widening slightly towards corpus bursae; colliculum present as a pair of weakly-sclerotized bar-like processes; ductus seminalis arising at approximately 0.1× length of ductus bursae; corpus bursae globose; signum absent.

Biology. Unknown, but presumed to feed as a leaf-tier or shoot borer on kōlea (*Myrsine* spp.) like its close relatives. Possible hosts from the type locality include *M. kauaiensis*, *M. lessertiana*, and *M. wawrae*.

Distribution. *Pararrhaptica huihui* is endemic to Kaua‘i, where it is known from a few remote locations in the Alaka‘i Swamp at elevations of approximately 1260–1380 meters.

Etymology. From Hawaiian “huihui,” meaning “constellation.” The pattern of scattered blue-purple scales on the otherwise dark forewing reminds us of constellations in the night sky. Polynesian navigators used wayfinding techniques, including use of constellations and individual stars, to find their way on long voyages back and forth across the Pacific Ocean.

Conservation Status. *Pararrhaptica huihui* is likely secure. *Pararrhaptica huihui* appears to be a fairly common species in the Alaka‘i Swamp and has

been recorded from multiple locations in recent years.

Spheterista hoihoi, sp. nov.

Figs. 2G, H; 6B; 8C, 9D

Diagnosis. *Spheterista hoihoi* (Kaua'i) is most likely to be confused with *Spheterista hakeaiki* Austin and Rubinoff (O'ahu), but can easily distinguished by its much larger size (5.7–10.2 mm in *S. hoihoi*, 4.5–6.2 mm in *S. hakeaiki* and the color of the median and postmedian fascia: black in *S. hoihoi*, reddish-brown in *S. hakeaiki*. In the male genitalia, the arms of the uncus of *S. hoihoi* are shorter and slightly curved (longer and nearly straight in *S. hakeaiki*). We could find no clear differences in the female genitalia, which are very uniform across *Spheterista*.

Type material. Holotype: Kaua'i: ♂, Nā Pali-Kona Forest Reserve, Mohihi-Waialai [Wai'alae]; 22.217 [22.117?], -159.601; 1050m; 16–17 x 2017; W. Haines, C. Gillett; MV light sheet / DNA extraction KA0129 / KAA diss. #0400 (UHIM). **Paratypes** (6♂♂, 6♀♀). Kaua'i: 1♂, Kōke'e Camp; 3600 ft [1097 m]; 9 iv [19]61; D. F. Hardwick / KAA diss. #0862 (CNC). 1♀, Nā Pali-Kona F[orest] R[eserve], Kalalau Lookout; 17 viii [20]06; D. Rubinoff, J. Eiben; UV light trap / DNA extraction KA0079 / KAA diss. #0358 (UHIM). 1♂, Kōke'e State Park, Nu'alolo Trail; 4 x 1973; K. and E. Sattler / BM genitalia slide 21342 (NHMUK). 1♀, Kōke'e State Park, Kaunuohua Ridge; 4000 ft [1219 m]; 30 viii 1973; K. and E. Sattler (NHMUK). 1♂, same as previous except 6 ix 1973 (NHMUK). 1♂, Kōke'e State Park, Kahuama'a Flat; 4000 ft [1219 m]; 3 ix 1973; K. and E. Sattler (NHMUK). 1♂, Kōke'e State Park, Kaluapuhi Trail; 4000 ft [1219 m]; 11 x 1973 K. and E. Sattler (NHMUK). 1♂, 2♀♀, Kōke'e State Park, Kauaikinanā (Mohihi Road); 3500 ft [1167 m]; 25 ix 1973 K. and E. Sattler (NHMUK). 2♀♀, Kōke'e; 6 vii 1937; E. C. Zimmerman; light trap (NHMUK).

Description. Male (n=7). ***Head.*** Scales on frons moderate, pure white on dorsal half; short, sparse or absent on ventral half, similarly white. Scales on vertex pure white. Labial palpus approximately 2× width of compound eye, porrect; lateral surface with scaling on first segment pure white, second segment predominantly dark gray, white scales restricted to dorsal and ventral edges, apical half; terminal segment pure white. Ocellus separated from compound eye by approximately width of ocellus. Scape pure white; sensillae moderate, approximately width of flagellomere; dorsal scales of flagellum entirely dark brown or black. ***Thorax.*** Dorsum with scaling entirely pure white except for black patch at posterior edge and at base of tegulae. Lateral surface of foreleg with scaling on coxa white, remainder of leg with scales shining light brown, tarsal segments occasionally darker brown to black; midlegs concolorous; hindlegs without white coxa, entirely pale brown to straw yellow. Dorsal surface of FW (Fig. 2H; FWL: 5.7–8.6 mm) with ground color pure white; basal fascia black with white patch at base, widest medially, reddish-orange along costa; median fascia black, incomplete, often only present from costa to midpoint of cell, occasionally present as a second segment along anterior portion of cell; subapical blotch present, black; small triangular black patch present near termen; short black streak often present along midpoint just before fringe; faint gray strigulae present throughout FW; fringe gray; costal fold absent. Dorsal surface of HW gray, strigulae well-developed; fringe gray. Ventral surface of FW gray with strigulae apparent, small white patches present along costa. Ventral surface of HW similar to dorsal surface but strigulae more contrasting. ***Abdomen.*** Vestiture of

abdomen pale grayish brown. Genitalia (Fig. 6B) with uncus bifid, arms widely separated at base, lateral margins slightly concave, curved apicoventrally, setae absent; socii large, sickle-shaped, with long hair-like setae on surface; arms of gnathos, thin, joined medially, forming a small posteriorly-directed process, largely obscured by an unusual finger-like process originating from between the arms of the uncus; tegumen robust, inflated; labides well-sclerotized, separate, dorsolaterally directed, with minute spinules; valvae subtrapezoidal; dorsomedial surface with very long, hair-like setae; sacculus well-developed, confluent with saccular margin at base before extending into disc of valva beyond; vinculum moderate; juxta large, plate-like, somewhat diamond-shaped, with V-shaped dorsomedial notch; phallus pistol-shaped, gently downcurved, slightly bulbous at base; caulis obsolete; three slender, spine-like cornuti present.

Female (n=6). Similar to male except averaging larger (Fig. 2H; FWL: 8.4–10.2 mm), sensillae minute; and without reddish-orange scaling along base of costa. Genitalia (Fig. 8C) with papillae anales thin, long, fused distally, evenly roughened on ventral surface; apophyses posteriores approximately length of S7; apophyses anteriores approximately 0.9× length of S7, slightly wider than apophyses posteriores; ovipositor telescopic; sterigma thin, bowl-shaped; ostium small, ring-like; colliculum not observed; ductus bursae slender, widening slightly near corpus bursae, approximately 1.5× length of S7; corpus bursae small, scarcely differentiated from ductus bursae, elliptical, membranous, without signum.

Biology. Unknown. Other species of *Spheterista* are known to feed as leaf-tiers, leaf-rollers, stem-borers, and fruit-feeders on various species of native Araliaceae. Potential hosts include *Cheirodendron* spp. and *Polyscias* spp.

Distribution. *Spheterista hoihoi* is endemic to Kaua‘i, where it is known from Kōke‘e State Park and the northern portion of the Alaka‘i Swamp at elevations from 1050–1219 meters.

Etymology. From Hawaiian “ho‘iho‘i” meaning “to send back” or “to repatriate,” indicating our strong desire to have insect specimens collected in Hawai‘i but deposited in museum collections in the continental U.S. and Europe returned to Hawai‘i where they can be more easily studied by entomologists working on the native Hawaiian insect fauna.

Conservation Status. Unknown. *Spheterista hoihoi* was apparently never collected by Perkins or Kusche in their surveys of Kaua‘i. It has only been found a handful of times in the past 50 years, indicating that it may have always been a rare species, even though it is known from a fairly wide area, especially throughout much of Kōke‘e State Park. Determining its host plant would greatly benefit the conservation prospects of this species.

Comments. Although the UHIM holotype (Fig. 9D) is not in as good condition as any of the NHMUK paratypes, we elected to designate it as the primary type so that it can remain in Hawai‘i, where it will be accessible to entomologists working in Hawai‘i in the future. We figure two NHUMK specimens (Fig. 2G, H) that are in exceptional condition.

Discussion

The nine species described here only represent a minute fraction of the total undescribed Lepidoptera diversity in Hawai‘i. Several hundred known, but undescribed species exist in museum collections. Some of these are still fairly common, even in highly degraded habitats, but the vast majority have become increasingly rare over the past few decades, even as modern collecting events

become more frequent and formerly inaccessible areas become accessible. The limiting factor is no longer a paucity of available material to describe new species, but a lack of taxonomists living and working in Hawai‘i able to describe the islands' biodiversity. We hope that the description of these nine new species will spark wider interest in Hawaiian insect diversity and encourage land managers, conservationists, and the general public to become more actively involved in the study and protection of insects before even more species go extinct, as appears to be the case for at least one species described here.

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